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Implementation Guidance for Radionuclides

draft

Disclaimer

This draft guidance document is based on the Final Radionuclides Rule and is not final EPA policy. The materials contained in this guidance are subject to change to address comments received on this draft. After modification, this guidance will be reissued in final form.

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Introduction

The purpose of this guidance manual is to provide assistance to EPA, States, and community water systems (CWSs) during the implementation of The Radionuclides Rule published in the *Federal Register* on December 7, 2000 (65 FR 76708).[1] Developed through a workgroup process involving EPA Regions, States, and stakeholders, the manual is organized as follows:

- Section I summarizes The Radionuclides Rule and presents a timeline of important dates.
- Section II addresses violation determination and associated reporting requirements and includes a violation table to assist States with compliance activities.
- Section III covers State Primacy Revision Requirements including a timeframe for application review and approval. This section also contains guidance and references to help States adopt new special primacy requirements included in The Rule.
- Section IV contains a series of "stand alone" guidance materials that will help States and CWSs comply with the new requirements.

The Appendices of this document provide information that will be useful to States and EPA Regions throughout the primacy revision application process and implementation of the Radionuclides Rule.

- Appendix A contains a series of diagrams which illustrate initial and reduced monitoring scenarios.

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- Appendix B contains a violation table arranged for data management and enforcement purposes.
- Appendix C contains the sample Extension Agreement between EPA and the States that will enable States and EPA to document how they will share rule implementation responsibilities if the State does not submit a primacy application by the deadline.
- Appendix D contains the primacy revision crosswalks for The Rule.
- Appendix E contains the State reporting guidance.
- Appendix F is EPA's Statement of Principles on the effect of State audit immunity/privilege laws on enforcement authority for federal programs.
- Appendix G contains training presentation materials for The Radionuclides Rule.
- Appendix H is a copy of the final Radionuclides Rule.
- Appendix I provides copies of beta and photon emitter conversion tables.

[1]Throughout this document, the December 7, 2000 Final Radionuclides Rule is referred to as The Radionuclides Rule, The Rule, or the new Rule. The Proposed Radionuclides Rule published in 1991 is referred to as the 1991 proposal or the 1991 proposed rule. The Radionuclides Rule published in 1976 is referred to as the 1976 Rule or the 1976 standard.

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- Appendix J lists references used to develop this guideance.

To help explain the provisions of The Radionuclides Rule, this guidance also includes a series of illustrations based on hypothetical systems CWSs of all sizes. The illustrations appear in boxes throughout the document and are for illustrative purposes only.

EPA and State decision-makers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate. Any decisions regarding a particular facility will be based on the applicable statutes and regulations. Therefore, interested parties are free to raise questions and objections about the appropriateness of the application of this guidance to a particular situation, and EPA will consider whether the recommendations or interpretations in the guidance are appropriate in that situation. EPA may change this guidance in the future.

This document does not substitute for EPA's regulation nor is this document regulation itself. Thus, it cannot impose legally binding requirements on EPA, States, or the regulated community, and may not apply to a particular situation based upon the circumstances.

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Section I.

Rule Requirements

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I-A. Executive Summary - Radionuclides Rule

Purpose

The purpose of this summary is to acquaint State decision-makers and other public health officials with the final rule for (non-radon) radionuclides in drinking water. The Radionuclides Rule was published in the *Federal Register* on December 7, 2000 (65 FR 76708). The Rule is applicable to CWSs, establishes a new maximum contaminant level (MCL) for uranium, which was not previously regulated, and revises the monitoring requirements for combined radium-226/228, gross alpha particle radioactivity, and beta particle and photon radioactivity. The Rule retains the existing MCLs for combined radium-226/228, gross alpha particle radioactivity, and beta particle and photon radioactivity.

Background

Regulations for radionuclides in drinking water were first promulgated in 1976 as interim regulations under the authority of the Safe Drinking Water Act (SDWA) of 1974. Standards were set for three groups of radionuclides: beta and photon emitters, radium (radium-226 and radium-228), and gross alpha radiation. These standards became effective in 1977. The 1986 SDWA Amendments added radon and uranium to the list of regulated radionuclides and required EPA to promulgate a revised radionuclide rule by June 1989. When EPA did not meet this deadline, a law suit was filed to require EPA to issue regulations. EPA entered into a series of consent agreements which set a schedule for issuing the non-radon radionuclide regulations by November 21, 2000.

In 1991, EPA proposed new regulations for uranium and radon and revisions to the existing radionuclides regulations. This proposal was not promulgated as a final rule. To meet the November 21, 2000 deadline set in the consent decree mentioned above, EPA published a Notice of Data Availability (NODA) in April 2000, which informed the public and the regulated community of new information concerning radionuclides in drinking water. The revised (non-radon) Radionuclides Rule, published on December 7, 2000, satisfies the requirements of the consent decree.

Benefits of the Radionuclides Rule

The Radionuclides Rule requires monitoring at each entry point to a CWSs distribution system to ensure that every customer's water meets the MCLs for radionuclides. (This requirement is consistent with the monitoring requirements for other, comparable drinking water contaminants.) By contrast, the 1976 Rule protected "the average customer" by requiring the collection of monitoring samples from a "free flowing tap."

The new uranium MCL will reduce the exposure of 620,000 persons to this contaminant, will protect CWS customers from exposure to uranium at levels that may cause kidney damage, and will reduce the risk of cancer caused by exposure to uranium. An estimated 0.8 cancer cases are expected to be avoided annually due to the MCL, resulting in estimated benefits of $3 million per year. (The monetary benefits from reduced kidney damage cannot be quantified because of limitation in existing health effects models at levels near the MCL). Reducing the presence of uranium in drinking water will also remove other contaminants, providing additional benefits to CWS customers.

In addition, the new Rule sets separate monitoring requirements for radium-228, which are expected to reduce the exposure of 420,000 persons and result in the avoidance of 0.4 cancer cases per year, with

estimated monetized health effects benefits of $2 million annually. Water mitigation for radium also tends to reduce iron and manganese levels and hardness, which also has significant associated benefits.

Applicability and Compliance Dates

The Radionuclides Rule applies to all CWSs (40 CFR 141.26). The regulations do not apply to noncommunity water systems.

The effective date of The Rule is December 8, 2003 (40 CFR 141.66(f)). Systems must monitor, in accordance with a State-specified plan, between the effective date and December 31, 2007, unless the State allows the use of grandfathered data (40 CFR 141.26(a)(1)).

Maximum Contaminant Levels and Maximum Contaminant Level Goals

The revised Radionuclides Rule promulgates an MCL for uranium and retains the existing MCLs for combined radium-226/228, gross alpha particle, and beta particle and photon radioactivity. The Rule also finalizes MCLGs, which are shown in Table I-1 (40 CFR 141.55).

Table I-1: MCLs and MCLGs for Regulated Radionuclides

Regulated Radionuclide	MCL	MCLG
Beta/photon emitters	4 mrem/yr	Zero
Gross Alpha Particle	15 pCi/L	Zero
Combined radium-226/228	5 pCi/L	Zero
Uranium	30 µg/L	Zero

Requirements of the Rule

Record Keeping and Reporting

The standard record keeping and reporting requirements for public water system (PWS) monitoring programs apply to the Radionuclides Rule (see 40 CFR 141.31 and 141.33 for PWS requirements and 142.14 and 142.15 for State requirements) and are discussed in detail in Sections I.C.2 and I.C.3 of this document.

Monitoring

Under the 1976 Rule, a water system with multiple entry points to its distribution system was not required to test at every entry point, but rather to monitor at the sources as well as “water from a free flowing tap.” (40 CFR 141.26(a)(3)(iii)). Under the new Rule, each entry point will be tested.

The standardized monitoring framework for radionuclides is complex, in part, because of the inter-relationship of the analytes; the alpha emitters, radium-226, and uranium contribute to gross alpha activity.

A detailed discussion of the monitoring requirements is included in Sections I.C.4 and I.C.8 of this document.

Grandfathered Data and Monitoring Waivers

Systems may not use grandfathered data to satisfy the monitoring requirements for beta and photon emitters (40 CFR 141.26(b)). However, under certain circumstances, States may allow data collected between June 2000 and December 8, 2003 to be used to comply with the initial monitoring requirements for gross alpha, radium-226/228, and uranium (40 CFR 141.26(a)(2)(ii)). A detailed discussion about the grandfathering of data can be found in the Section I.C.5 of this document.

States cannot issue waivers for the reduced radionuclide monitoring requirements. However, States may waive the final two quarters of initial monitoring for gross alpha, uranium, radium-226, and radium-228, if the sampling results from the previous two quarters are below the detection limit[2] (40 CFR 141.26(a)(2)(iii)). (See Section I.C.6 of this document for more detail on monitoring waivers.)

Requirements for New Systems/Sources

New systems, and systems that begin using a new source of supply, must conduct initial monitoring for gross alpah, radium-226/228, and uranium during the calendar quarter that follows the quarter in which they begin using the new source of supply (40 CFR 141.26(a)(1)(ii)). A detailed discussion and annotated example are provided in Section I.C.7 of this document.

Laboratory Methods

Many testing procedures for regulated radionuclides were approved in 1976 and many additions or changes to analytical methods were included in the 1991 proposed Rule. EPA approved 66 radiochemical methods in the March 5, 1997 radionuclides methods rule (40 CFR 141.25). As of this manual's publication, approximately 90 radiochemical methods are approved for compliance monitoring of radionuclides in drinking water. These methods and various quality control requirements are detailed in Section I.C.9 of this document. EPA is continuing to evaluate additional analytical methods for approval.

Treatment Technologies and Costs

EPA has evaluated several technologies for removing radionuclides from drinking water. Details on EPA's review of the 1999 draft of "Technologies and Costs," the EPA 1998 radium compliance cost study, the 1998 *Federal Register* announcement of *Small System Compliance Technology Lists for Existing National Primary Drinking Water Regulations Concerning Variance Technologies* (63 FR 42032), and the November, 2000 Radionuclides Economic Analysis are included in Section I.C.10 of this document.

Cost information is available in an Appendix to the 1999 "Technologies and Costs" document and in the 1998 radium compliance cost study. The cost study gathered data from 29 systems in 8 States to compare costs of different technologies. Reverse osmosis was the most expensive technology identified, and ion

[2]Regulatory detection limits, for the regulated radionuclides except uranium, are defined in 40 CFR 141.25(c). EPA will propose a detection limit for uranium in a future rulemaking before the compliance date of The Radionuclides Rule. The detection limit will be consistent with the sensitivity measures used for other radionuclides.

exchange was one of the least expensive. Additional information on costs of compliance are included in Section I.C.10 of this document and in the preamble to The Radionuclides Rule.

Variance and Exemptions

All systems are eligible for a variance from the MCLs for gross alpha, combined radium-226/228, uranium, and beta particle and photon emitters. However, to qualify for a variance a system must meet the requirments of Section 1415(a) of the Safe Drinking Water Act (SDWA). Small system variances are not available, however, for any contaminant regulated under the Radionuclide Rule because EPA has identified affordable small system compliance technologies. (See Section I.C.10 for a summary of small system compliance technologies including a table that summarizes the compliance technologies, by system size category.) Additional information on variances appears in Section I.C.11.

The maximum exemption period is 9 years from the effective date of an MCL. EPA retained the MCLs promulgated in 1976 for gross alpha, radium-226/228, total beta particle and photon emitters, so the exemption period has expired. Since the Agency has promulgated a new MCL for uranium, a State may issue a uranium exemption to a CWS if the system meets the criteria of SDWA 1416. (See Section I.C.11.b for more information on exemptions.)

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I-B. Key Dates of the Rule

The effective date for the Radionuclides Rule is December 8, 2003. The 1976 Rule remains in effect then. Under the new Rule, all CWSs are required to complete the initial monitoring requirements by December 31, 2007 (40 CFR 141.26). A system that collects samples for gross alpha, radium-226/228, and uranium between June 2000 and December 8, 2003 may be able to grandfather this data under certain circumstances, and therefore may not have to conduct initial monitoring (40 CFR 141.26(a)(2)(ii)).

Unless the State allows a system to grandfather data, the system must monitor, in accordance with a State specified plan, between December 8, 2003 and December 31, 2007. Monitoring during this time period will synchronize radionuclides monitoring with the standardized monitoring framework (specifically Phase II/V organic and inorganic monitoring) and help to alleviate potential laboratory capacity problems. Systems will be able to collect radionuclide samples in conjunction with the inorganic, synthetic organic, and volatile organic contaminant samples, which must be collected by December 31, 2007.

A timetable of key dates and a time line illustrating the radionuclides monitoring requirements within the standardized monitoring framework are presented in Table I-2 and Figure I-1, respectively.

Table I-2: Public Water System Timetable for the Radionuclides Requirements

Date	Radionuclides Requirements
July 9, 1976	1976 Radionuclides Drinking Water Regulation.
July 18, 1991	1991 Proposed Radionuclides Rule.
April 2000	Revised Radionuclides Notice of Data Availability (NODA).
June 2000	Under certain circumstances, data collected between June 2000 and December 8, 2003 may be eligible for use as grandfathered data to satisfy the initial monitoring requirements for gross alpha, radium-226/228 and uranium. (Note: The use of grandfathered data is at the State's discretion.)
December 7, 2000	The Final Radionuclides Rule.
September 8, 2002	EPA's suggested deadline for States submission of complete and final primacy revision application packages.
December 8, 2002	Regulatory deadline for States to submit primacy revision application packages.
December 8, 2003	Systems must begin initial monitoring under a State specified monitoring plan unless the State permits the grandfathering of data collected between June 2000 and December 8, 2003.
December 8, 2003	Rule effective date.
December 8, 2004	State primacy revision application package due for States requesting 2-year extensions.
December 31, 2007	All systems must complete initial monitoring.

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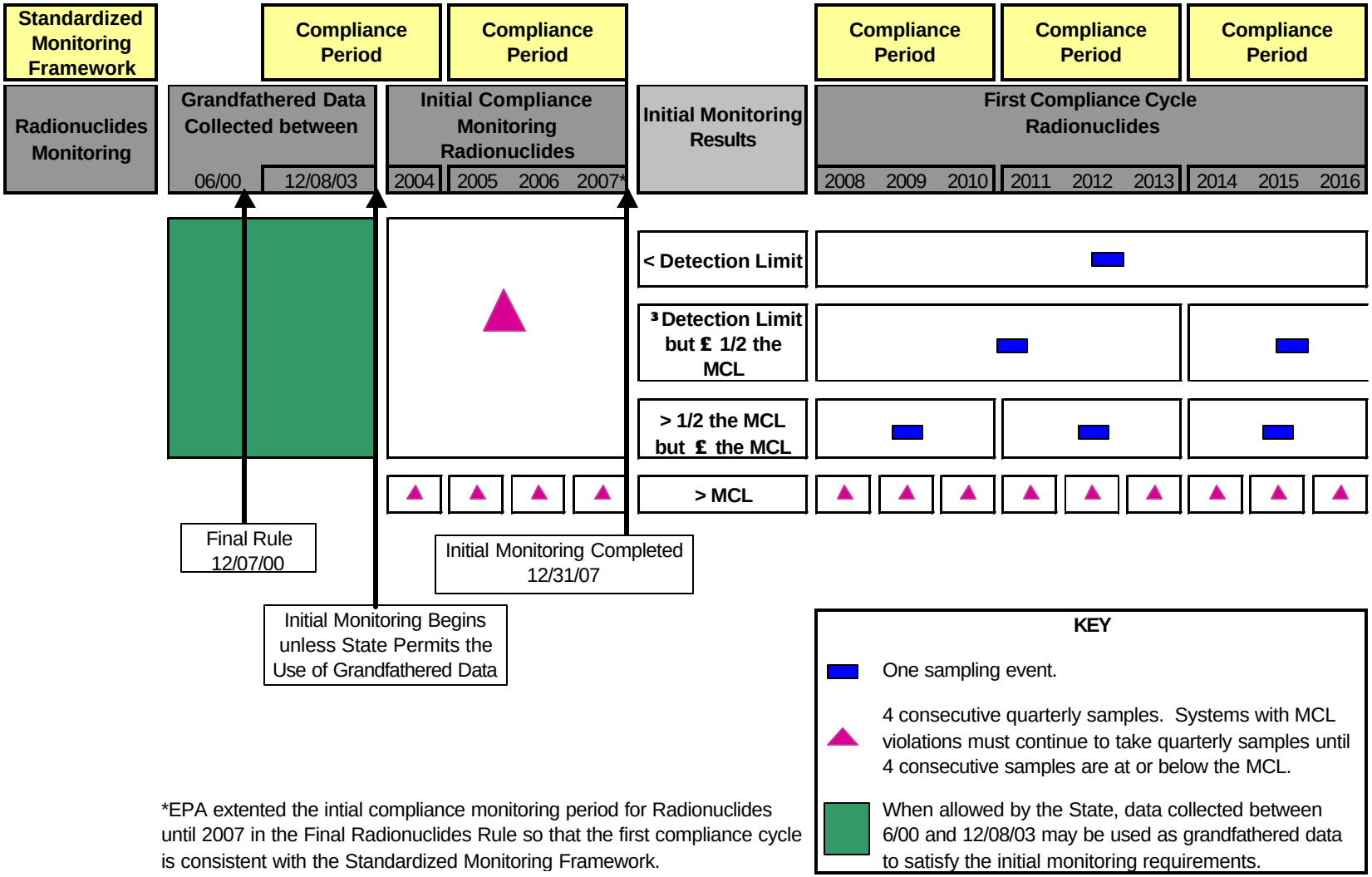
Figure I-1: Applicability of the Standardized Monitoring Framework to Radionuclides

(Excluding the Beta Particle and Photon Emitters)



*EPA extented the intial compliance monitoring period for Radionuclides until 2007 in the Final Radionuclides Rule so that the first compliance cycle is consistent with the Standardized Monitoring Framework.

I-C. Rule Summary - Radionuclides Rule

I-C.1 Background

Regulations for radionuclides in drinking water were first promulgated in 1976 as interim regulations under the authority of the 1974 SDWA . The standards were set for three groups of radionuclides: beta and photon emitters, radium (radium-226 and radium-228), and gross alpha radiation. These standards became effective in 1977.

The 1986 SDWA Amendments identified 83 contaminants for EPA to regulate, including the already regulated radionuclides, which lacked MCLGs, and two additional radionuclides, uranium and radon. The 1986 Amendments also declared the 1976 interim standards to be final National Primary Drinking Water Regulations (NPDWRs) and provided a statutory deadline of June 1989 for EPA to promulgate a revised radionuclide rule.

When EPA failed to meet this statutory deadline, a plaintiff in Oregon brought suit to require EPA to issue the regulations. EPA entered into a series of consent agreements which set a schedule for issuing the regulations for non-radon radionuclides by November 21, 2000.

In 1991, EPA proposed new regulations for uranium and radon, as well as revisions to the existing radionuclides regulations. The proposal included the following features: (1) an MCLG of zero for all ionizing radiation; (2) revised MCLs for beta particle and photon radioactivity, radium-226, radium-228, and gross alpha emitters; (3) proposed MCLs for uranium and radon; and (4) revisions to the categories of systems required to monitor, the monitoring frequencies, and the appropriate screening levels. EPA received comments on the new data and regulatory options presented in the 1991 proposal, however, the proposal was never promulgated as a final rule, in large part because of the controversy surrounding the proposed MCL for radon.

To meet the consent decree deadline, EPA published a Notice of Data Availability (NODA) in April 2000. The NODA which informed the public and the regulated community of new information concerning radionuclides in drinking water. The 1996 SDWA Amendments directed the Agency to withdraw the proposed MCL for radon, which was done on August 6, 1997 (62 FR 42221), and provided a framework for a radon-specific regulation. The revised (non-radon) Radionuclides Rule, published on December 7, 2000, satisfies the requirements of the consent decree.

I-C.2 Record Keeping

I-C.2.a State Record Keeping Requirements

The standard record keeping requirements for States under the SDWA apply to The Radionuclides Rule (40 CFR 142.14). Each State which has primary enforcement responsibility shall maintain records of tests, measurements, analyses, decisions, and determinations performed on each PWS to determine compliance with applicable provisions of State primary drinking water regulations. States must keep the following records for the stated period of time:

- Certifications of compliance with the public notification requirements received from PWSs, copies of the public notices received from PWSs, and records of any State determinations establishing alternative public notification requirements for 3 years (40 CFR 142.14(f)).

- Records pertaining to each radionuclide variance and exemption determination for 5 years following the expiration of the variance or exemption (40 CFR 142.14(e)).

- Current inventory information for every PWS in the State for 12 years (40 CFR 142.14(c)).

- Records of any State approvals for 12 years (40 CFR 142.14(d)(2)).

- Records of any radionuclide enforcement action for 12 years (40 CFR 142.14(d)(3)).

- All current radionuclide monitoring requirements and the most recent monitoring frequency decision pertaining to each contaminant, including the monitoring results and other data supporting the decision, the State's findings based on the supporting data and any additional bases for such decision. This information shall be kept in perpetuity or until a more recent monitoring frequency decision has been issued (40 CFR 142.14(d)(5)).

- Records of determinations of a system's vulnerability to contamination from beta and photon emitters, including the monitoring results and other data supporting the determination, the State's findings based on the supporting data, and any additional bases for such decisions. This information must be kept in perpetuity or until a more recent vulnerability assessment has been issued (40 CFR 142.14(d)(4)).

I-C.2.b PWS Record Keeping Requirements

The standard record keeping requirements for PWSs under the SDWA apply to The Radionuclides Rule (40 CFR 141.33).

Owners and operators must keep the following records for the stated period of time:

- Records of action taken by the system to correct violations of the radionuclide regulation for at least 3 years after the last action taken with respect to the particular violation involved (40 CFR 141.33(b)).

- Copies of radionuclide public notices, and certifications made to the primacy agency must be kept for at least 3 years after their issuance (40 CFR 141.33 (e)).

- Records concerning a radionuclide variance or exemption granted to the system for at least 5 years following the expiration of such variance or exemption (40 CFR 141.33(d)).

- Records of analyses for at least 10 years. Data may be kept as laboratory reports or can be transferred to tabular summaries. The summaries should include the date, place, and time of sampling; the name of the person who collected the sample; identification of the sample as a routine distribution system sample, check sample, raw or process water sample, or other special purpose sample; date of analysis; laboratory and person responsible for performing analysis; the analytical technology/method used; and the results of the analysis (40 CFR 141.33(a)).

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I-C.3 Reporting and Public Notification

I-C.3.a State Reporting Requirements

The standard reporting requirements for States under the SDWA apply to The Radionuclides Rule (40 CFR 142.15). States must submit, among other things, quarterly reports to EPA that detail:

- All violations of The Radionuclide Rule committed by PWSs during the previous quarter (40 CFR 142.15(a)(1)). The Agency recognizes that States have interpreted analytical results in a variety of ways. However, compliance and reduced monitoring frequencies should be calculated based solely on the analytical result not including (i.e. not adding or subtracting) the standard deviation. Therefore, the State should report MCL violations to EPA only if the analytical result (not taking the standard deviation into account) exceeds the MCL. (See Illustration I-1.)

ILLUSTRATION I-1
Reporting Analytical Results

A system samples for gross alpha at its one entry point to the distribution system during 2005. The laboratory report sent to the system indicates that the gross alpha measurement for the sampling point is 18 ± 2 pCi/L.

The system reports the entire result (18 ± 2 pCi/L) to the State. The State reports to EPA that the system has violated the MCL because compliance, reduced monitoring and reporting is calculated using a value of

- Enforcement actions taken by the State during the previous quarter to enforce State radionuclide regulations (40 CFR 142.15(a)(2)).

- The variances or exemptions granted during the previous quarter. The State must provide a statement of the reasons for granting the variance or exemption, including documentation of the need for the variance or exemption and the finding that the granting of the variance or exemption will not result in an unreasonable risk to health (40 CFR 142.15(a)(3)).

States must also submit an annual report that identifies any changes (additions, deletions, or corrections) to the State's PWS inventory and includes a summary of the status of each variance and exemption currently in effect (40 CFR 142.15(b)).

I-C.3.b PWS Reporting Requirements

The standard reporting requirements for PWS monitoring programs under the SDWA apply to The Radionuclides Rule (40 CFR 141.31).

- The laboratory or system must report analytical results, including the standard deviation, to the State. Systems cannot round a result. In accordance with State regulations, the system must report results within either the first 10 days following the month in which the results are received, or the first 10 days following the end of the required monitoring period, whichever of these is shortest (40 CFR 141.31(a) & (c)).

- The laboratory or system must report to the State within 48 hours the failure to comply with any radionuclide MCL or monitoring requirement (40 CFR 141.31(b) & (c)).

- The water system must provide copies of each radionuclide public notice and a letter certifying that the system has met all the public notification requirements. The copies and letter are required within 10 days of the completion of each public notice (40 CFR 141.31).

I-C.3.c PWS Public Notification Requirements

Systems must provide public notice for violations and in certain other circumstances. The revised Public Notification (PN) Rule (40 CFR Part 141, Subpart Q) groups the public notice requirements into 3 tiers based on the seriousness of the violation or situation.[3] "Tier 1" applies to violations and situations with significant potential to have serious adverse effects on human health as a result of short-term exposure. Notice is required within 24 hours of the violation. "Tier 2" applies to other violations and situations with the potential to have serious adverse effects on human health. Notice is required within 30 days. Primacy agencies may grant extensions of up to 3 months from the time of the violation under certain conditions. "Tier 3" applies to all other violations and situations requiring a public notice not included in Tier 1 or Tier 2. Notices for Tier 3 violations can be combined into one annual notice, including the Consumer Confidence Report (CCR), if timing and delivery requirements can be met.

The Radionuclides Rule requires CWSs to provide a Tier 2 public notice for MCL violations and a Tier 3 public notice for violations of the monitoring and testing procedure requirements (40 CFR Part 141, Subpart Q, Appendix A).

I-C.3.d PWS Consumer Confidence Report Requirements

All CWSs must deliver a CCR to their customers by July 1 of each year. (40 CFR 141.152(a)). The CCR provides a snapshot of water quality over the preceding year. CCRs must include water quality data, monitoring results and an explanation of their significance, and health effects language and "likely source" information for MCL and treatment technique violations.

The Radionuclides Rule updates the specific health effects language and likely source information for the regulated radionuclides (40 CFR Part 141, Subpart Q, Appendix B). The health effects language and likely sources for radionuclides are shown in Table I-3.

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[3]For Direct Implementation programs, the revised PN Rule went into effect October 31, 2000. Primacy States may set new compliance dates that shall be no later than May 6, 2002.

Table I-3: Standard Health Effects Language for CCR and Public Notification

Contaminant	Major Sources in Drinking Water	Standard Health Effects Language for CCR and Public Notification
Beta/photon emitters	Decay of natural and man-made deposits.	Certain minerals are radioactive and may emit forms of radiation known as photons and beta radiation. Some people who drink water containing beta and photon emitters in excess of the MCL over many years may have an increased risk of getting cancer.
Alpha Emitters	Erosion of natural deposits.	Certain minerals are radioactive and may emit a form of radiation known as alpha radiation. Some people who drink water containing alpha emitters in excess of the MCL over many years may have an increased risk of getting cancer.
Combined Radium-226/228	Erosion of natural deposits.	Some people who drink water containing radium 226 or 228 in excess of the MCL over many years may have an increased risk of getting cancer.
Uranium	Erosion of natural deposits.	Some people who drink water containing uranium in excess of the MCL over many years may have an increased risk of getting cancer and kidney toxicity.

I-C.4 Monitoring for Gross Alpha, Radium-226, Radium-228, and Uranium

This section presents the initial, reduced, and increased monitoring requirements for gross alpha, radium-226, radium-228, and uranium. The Radionuclides Rule makes the radionuclides monitoring requirements consistent with monitoring for other inorganic contaminants (IOCs) regulated under the Phase II/V standard monitoring framework. For monitoring purposes, The Rule changes the point of compliance from a representative point in the distribution system to each entry point to the distribution system (EPTDS) (40 CFR 141.23(a)(1) and (2)). Systems that use an intermittent source of supply (i.e. a supply affected by seasonal variation) or that use more than one source and the sources are combined before distribution, must sample at an EPTDS during periods of normal operating conditions (i.e. when water is representative of all the sources being used) (40 CFR 141.23(a)(3)).

Systems do not have to sample at each EPTDS to satisfy the monitoring requirements if:

- The State has determined that conditions make another sampling point more representative of each source (40 CFR 141.26(a)(1)(i)).
- The State has modified the monitoring requirements of a PWS that supplies water to one or more other PWSs and the interconnection of the systems justifies treating them as a single system for monitoring purposes (i.e., consecutive PWSs) (40 CFR 141.29).

To satisfy the **INITIAL** monitoring requirements, systems do not have to sample at each EPTDS if:

- The State has determined, through examination of appropriate historical data and of monitoring data taken between June 2000 and December 8, 2003, that each EPTDS is expected to be in compliance (i.e., the State has allowed the system to grandfather data) (40 CFR 141.26(a)(2)(ii)).

However, the system must take samples from each EPTDS in all future monitoring. The use of grandfathered data is further described below in the Section I-C.5.

Included in this Section are tables which summarize the monitoring framework for radionuclides and illustrations that help explain the initial and reduced monitoring requirements. Diagrams which illustrate initial and reduced monitoring scenarios are also included in Appendix A. While the figures and the examples help to illustrate many of the potential scenarios, States may encounter many additional situations because of the unique characteristics of individual systems. The illustrations and the figures in Appendix A are only guides to help determine monitoring frequencies for some systems.

I-C.4.a. Radium-224

Recent studies have shown that there is a positive correlation (1:1) between radium-228 and radium-224. Since systems with high radium-224 levels will likely also have high radium-228 levels, EPA expects that the enforcement of a combined radium-226/228 MCL will mitigate the effects of high radium-224 levels. Although monitoring for radium-224 is not a requirement in this Rule, a State, at its own discretion, may require water systems to analyze for radium-224.

I-C.4.b Initial Monitoring for Gross Alpha, Radium-226/228, and Uranium

Systems are required to conduct initial monitoring at each EPTDS by December 31, 2007 for gross alpha, radium-226, radium-228, and uranium (40 CFR 141.26). The gross alpha particle activity measurement may be substituted for the required radium-226 measurement if the gross alpha particle activity does not exceed 5 pCi/L (See Section I-C.4.e below). The gross alpha particle activity measurement may be substituted for the required uranium measurement if the gross alpha particle activity does not exceed 15 pCi/L (See Section I-C.4.f below).

Ideally, a system would establish initial compliance by collecting four consecutive quarterly samples at each EPTDS during the

ILLUSTRATION I-2
Consecutive Quarters

A groundwater system serving 5,000 people conducts all required monitoring for radionuclides at its one EPTDS during April, July, and November of 2005. The system did not monitor during the first quarter of 2005.

All sample results were between the detection limit and one-half the MCL.

The State:

- Determines that the system is in compliance since the running annual average at the EPTDS (based on the three samples) is below the MCL for each radionuclide.
- Requires the system to take the fourth sample in the first quarter of 2006 in order to satisfy the initial monitoring requirements of the Radionuclides Rule.

The system reports that the 2006 samples were all above the detection limit but less then one-half the MCL for each radionuclide, the State requires the system to sample once during the next 6 years.

initial round of monitoring.[4] The reason is to provide contaminant information during each of the four seasons. Strict adherence to this goal, however, could create a situation where systems may take numerous quarterly samples (all of which show no detects) but still never satisfy the initial monitoring requirements because they never achieve monitoring for four consecutive quarters. It is not EPA's intent to require this of systems.

EPA suggests that the State require the system to either collect the fourth sample as soon as possible, or collect the sample the following year in the quarter that was missed. Compliance must be based on the running annual average of the collected samples. Once the system satisfies the initial monitoring requirements, the State can determine the reduced monitoring schedule at that entry point (See Illustration I-2).

Systems that do not have previous radionuclide sampling data should sample for gross alpha, radium-226, and radium-228. Data collected during the first quarter may serve as a baseline indicator of what will need to be collected at each EPTDS in the following quarters. These systems will then collect subsequent quarterly samples concurrently with all other quarterly sampling events to determine compliance with the MCLs. (See Illustration I-3.[5])

ILLUSTRATION I-3
A System Without Previous Sampling Results

A ground water system serving 500 people has never collected gross alpha, radium-226, and radium-228 samples. As a result of an enforcement action, the system monitors during the first two quarters of the initial monitoring period.

All of the samples are less than the regulatory detection limits.

The State waives the last two quarterly samples and sets up a reduced monitoring schedule of once every nine years for gross alpha, radium-226/228, and

I-C.4.c Reduced Monitoring for Gross Alpha, Combined Radium-226/228, and Uranium

Standard trigger levels (the method detection level, one-half the MCL, and the MCL) are used to guide the determination of a system's reduced monitoring frequency at each EPTDS. If an entry point's annual average from the initial four quarters of monitoring for gross alpha, uranium, combined radium-226/228 is below the detection limit, the system would be allowed to reduce monitoring to one sample every 9 years at that entry point (40 CFR 141.26(a)(3)(i)).[6] If an entry point's annual average for gross alpha, uranium and combined radium-226/228 is at or above the detection limit but at or below one-half the MCL, the system could reduce monitoring to one sample every 6 years at that entry point (40 CFR 141.26(a)(3)(ii)). If an entry point's annual average for gross alpha, uranium and combined radium-226/228 is above one-half the MCL but at or below the MCL, the system could reduce monitoring to one sample every 3 years at that entry

[4]States may waive the final two quarters of initial monitoring if the entry point's results of the first two quarters are below the detection limit. The system is then required, under the reduced monitoring requirements, to sample once every 9 years at that entry point (40 CFR 141.26(a)(2)(iii)).

[5]For additional illustrations and examples please see Appendix E: SDWIS-FED DTF Reporting Requirements Guidance.

[6]Since uranium was not previously regulated a detection limit is not listed in the Code of Federal Regulations. EPA will propose a detection limit for uranium in future rulemaking and before the compliance date of the Radionuclides Rule. The detection limit will be consistent with the sensitivity measures used for other radionuclides.

point (40 CFR 141.26(a)(3)(iii)). Table I-4 below and flow diagrams in Appendix A, in conjunction with the results from the initial sampling, can help determine a schedule for reduced monitoring.

Entry points that exceed the MCL while on a reduced monitoring schedule must immediately return to quarterly sampling (40 CFR 141.26(a)(3)(v)). A system's entry point is eligible for a reduced monitoring schedule only if the average of the initial monitoring results are below the MCL, or grandfathered data supports the reduction. The State can also specify a different schedule as part of a formal enforcement action, variance, or exemption.

ILLUSTRATION I-5
Use of Gross Alpha for Radium-226

The regulatory detection limit for gross alpha is 3pCi/L. The rule specifies that a system must use 1.5 pCi/L (one-half the detection limit for gross alpha) as the value to determine future monitoring frequency if the system substitutes a gross alpha particle activity measurement for radium-226 (40 CFR 141.26(a)(7)). Since 1.5 pCi/L is not less than the regulatory detection limit for radium-226 (1pCi/L) and assuming the radium-228 is less than or equal to 1 pCi/L, the system would not be allowed to move to the reduced monitoring frequency of once every 9 years.

I-C.4.d Increased Monitoring for Gross Alpha, Radium-226/228, and Uranium

Systems with EPTDSs on a reduced monitoring schedule (i.e., collecting one sample every 3, 6, or 9 years) may remain on that reduced schedule as long as the most recent sample results support that monitoring schedule. An increase in a contaminant concentration may increase the monitoring frequency for that contaminant. (See Illustration 1-4.)

Any system that has an entry point monitoring result above the MCL while on reduced monitoring must increase the frequency of monitoring at that entry point to quarterly sampling. Quarterly sampling must continue until four consecutive quarterly samples are below the MCL (40 CFR 141.26(a)(3)(v)). As with the initial monitoring requirements, States may require a system that fails to take a quarterly sample to either collect the fourth sample as soon as possible, or collect the sample the following year in the quarter that was missed.

ILLUSTRATION I-4
Gross Alpha = 7 pCi/L (initial monitoring result)
Gross Alpha = 8 pCi/L (reduced monitoring result)

A system collects four quarterly samples for gross alpha during the initial monitoring period. The annual average is 7pCi/L (i.e., above the detection limit but less than one-half the MCL). The system may reduce sampling to one sample every 6 years for gross alpha (one sample between 2008 - 2013). The system collects its 6 year sample and the results show an increase in the gross alpha concentration to 8 pCi/L. The system is required to increase the monitoring frequency to once every 3 years (one sample between 2014 - 2016) because the result was above one-half the MCL but at or below the MCL.

I-C.4.e Use of Gross Alpha Measurements for Radium-226

The standard monitoring framework for radionuclides is complex, in part, because of the inter-relationship of the analytes (i.e., the alpha emitters, radium-226, and uranium contribute to gross alpha activity). Due to this relationship, gross alpha particle activity analytical results can be used to determine the reduced monitoring frequency for gross alpha, radium-226, and uranium. Systems that submit only gross alpha particle activity analytical results and do not sample for radium-226 may be required, under the reduced monitoring requirements, to sample once every 3 or 6 years rather than once every 9 years. This is due to the fact that the detection limit for gross alpha will not allow confirmation that radium-226 is below the respective detection limit as measured individually. (See Illustration I-5.)

EPA is recommending that systems substitute gross alpha for radium-226 only if previous gross alpha results are less than the gross alpha detection limit (i.e. 3pCi/L). If the gross alpha particle activity result is less than detection, one-half the detection limit (i.e. 1.5pCi/L) is used for radium-226 and is added to the radium-228 activity. The combined radium-226/228 value must be used to determine compliance and future monitoring frequency (40 CFR 141.26(a)(5)). If the gross alpha particle activity result is above the detection limit, compliance and future monitoring frequency are determined using the whole gross alpha result. With a gross alpha result at or above 3 pCi/L, the system is at risk for violating the combined radium-226/228 MCL of 5pCi/L and therefore should monitor individually for radium-226/228.

ILLUSTRATION I-6
Uranium Conversion and Calculation of "Net Alpha"

A system collects samples for gross alpha and uranium. The laboratory reports the following analytical results to the State.

- Gross alpha: 24 ± 3 pCi/L (EPA method 900.0)
- Uranium: 21 µg/L (EPA method 900.8)

Based on the above results, the State determines:

- The uranium mass was converted by multiplying the measured value by 0.67 pCi/µg (i.e. 21 µg/L x 0.67 pCi/µg = 14 pCi/L). The converted uranium activity (14 pCi/L) was subtracted from the measured gross alpha (24 pCi/L) yielding 10 pCi/L "net alpha". The "net alpha" value was used to determine compliance with the gross alpha MCL (15 pCi/L).
- The system is in compliance with the uranium MCL and is required to collect a uranium sample in the next 3-year compliance period (i.e., 1 sample every 3 years for results >½ the MCL but ≤MCL).
- The system is in compliance with the gross alpha MCL and is required to collect another gross alpha sample in the next 3-year compliance period (i.e., the calculated "net alpha" value of 10 pCi/L is >½ the MCL but ≤MCL).

I-C.4.e Use of Gross Alpha Measurements for Uranium

A gross alpha particle activity measurement may be substituted for the required uranium measurement if the gross alpha particle activity is less than or equal to 15 pCi/L. States must assume all of the gross alpha activity is due to uranium and a mass to activity ratio of 1:1 must be used. If the gross alpha particle activity is greater than 15 pCi/L, then samples must be collected for uranium (40 CFR 141.26(a)(5)).

Uranium analysis will serve a dual purpose for systems with EPTDSs that have high levels of gross alpha activity. First, the uranium activity can be subtracted from gross alpha to determine compliance with an EPTDS's gross alpha MCL. Second, the results can be used to determine an entry point's future monitoring frequency for uranium.

I-C.4.f. Uranium Mass to Activity Ratios and Determining Compliance with the Gross Alpha MCL

States may subtract the uranium activity from the gross alpha particle activity to determine compliance with the gross alpha MCL, which is referred to in this section as "net alpha" (i.e. gross alpha particle activity minus the uranium activity). Unless an activity measurement has been analyzed and reported to the State by the laboratory, the State must convert the uranium mass measurement to activity using a conversion factor of 0.67 pCi/µg. States may also convert uranium activity values to mass by multiplying the uranium activity by 1.49 µg/pCi (40 CFR 141.25 Footnote 12). (See Illustration I-6.)

At this time, conversion factors that have been calculated by assessing the uranium mass to activity ratios for individual systems may not be used (40 CFR 141.25 Footnote 12). However, if the uranium analysis is

reported in mass and activity, the laboratory-analyzed uranium activity level may be used for determining compliance with the "net alpha" MCL.

Systems and laboratories must report the gross alpha particle activity and the uranium analytical results to the State. The State is responsible for subtracting the uranium activity from the gross alpha particle activity to determine compliance with the "net alpha" MCL.

I-C.4.g Compositing

States may allow systems to collect up to four consecutive quarterly samples from a single EPTDS and have the laboratory composite them.[7] The laboratory that analyzes the samples must use a method with a detection limit of one-fifth the MCL (40 CFR 141.26(a)(4)). If the four composited samples are above one-fifth the MCL, the system must take follow-up samples at each sampling point within 14 days (40 CFR 141.23(a)(4)). Compliance determinations will be based on the follow up sample result.

States may allow systems to collect samples and have the laboratory composite them temporally (i.e., samples that are collected from the same sampling point during different quarters). Temporal compositing is allowed for uranium, gross alpha, radium-226 (provided a detection limit of 1 is met) and radium-228 (provided a detection limit of 1 is met) for up to four consecutive quarterly samples if analysis is done within one year of the first sample.

draft

[7]The beta and photon emitters have unique compositing requirements.

Table I-4: Summary of Monitoring Frequencies for Gross Alpha, Uranium, and Radium-226/228

<table>
<tr><th>Initial
40 CFR 141.26(a)(2)</th><th colspan="2">Reduced
40 CFR 141.26(a)(3)</th></tr>
<tr><td colspan="3">GROSS ALPHA AND URANIUM</td></tr>
<tr><td rowspan="3">Four consecutive quarters of monitoring at each entry point.*

* Systems may substitute the gross alpha results that are less than or equal to 15 pCi/L for uranium to determine compliance and the reduced monitoring frequency. Systems with a gross alpha result greater than 15 pCi/L must collect uranium sample(s) to determine compliance and reduced monitoring. (40 CFR 141.26(a)(5)).</td><td rowspan="3">One sample every:</td><td>Nine years if the average of the initial monitoring for each contaminant is below the detection limit listed in 40 CFR 141.25(c).</td></tr>
<tr><td>Six years if the average of the initial monitoring results for each contaminant is at or above the detection limit but at or below one-half the MCL.</td></tr>
<tr><td>Three years if the average of the initial monitoring results for each contaminant is above one-half the MCL but at or below the MCL.</td></tr>
<tr><td>Systems may composite up to four consecutive quarterly samples from a single entry point if analysis is done within a year of the first sample.</td><td colspan="2">If the result from the composited samples is less than or equal to one-half the MCL, reduce in accordance with the above schedule. A State may require a system to take additional quarterly samples before allowing the system to reduce the frequency of monitoring if the result from the composited samples is greater than one-half the MCL (40 CFR 141.26(a)(4)).</td></tr>
<tr><td colspan="3">COMBINED RADIUM-226 AND RADIUM-228</td></tr>
<tr><td rowspan="3">Four consecutive quarters of monitoring at each entry point.*

* Systems may substitute the gross alpha results that are less than or equal to 5 pCi/L for radium-226 to determine compliance and the reduced monitoring frequency. Systems with a gross alpha result greater than 5 pCi/L must collect radium-226 samples to determine compliance and reduced monitoring. (40 CFR 141.26(a)(5)).</td><td rowspan="3">One sample every:</td><td>Nine years if the average of the initial monitoring for combined radium-226/228 is below the detection limit listed in 40 CFR 141.25(c).</td></tr>
<tr><td>Six years if the average of the combined initial monitoring results for combined radium-226/228 is at or above the detection limit but at or below one-half the MCL.</td></tr>
<tr><td>Three years if the average of the initial monitoring results for combined radium-226/228 is above one-half the MCL but at or below the MCL.</td></tr>
<tr><td>Systems may composite up to four consecutive quarterly samples from a single entry point if analysis is done within a year of the first sample.</td><td colspan="2">If the result from the composited samples is less than or equal to one-half the MCL, reduce in accordance with the above schedule. A State may require a system to take additional quarterly samples before allowing the system to reduce the frequency of monitoring if the result from the composited samples is greater than one-half the MCL (40 CFR 141.26(a)(4)).</td></tr>
</table>

I-C.5 Grandfathered Data

The Radionuclides Rule balances the need to ensure that the concentrations of regulated radionuclides are at or below the MCL at each EPTDS with the recognition that some systems have been monitoring for certain radionuclides for almost 25 years. The Rule also provides States the flexibility to decide, on a case-by-case analysis of a system's historical data or individual circumstances, whether to approve the use of grandfathered data and the number of samples required to provide a sufficient indication that the radionuclide activity will remain below the observed levels. A State must describe in its Primacy Application, the procedures and criteria that it will use to determine the acceptability of grandfathered data (40 CFR 142.16(l)(1)).

States may allow systems to use grandfathered data to comply with the initial monitoring requirements for gross alpha, radium-226/228, and uranium under some circumstances, including the following:

- Systems with one EPTDS collect monitoring data between June 2000 and December 8, 2003 (See Illustration I-7);
- Systems with multiple EPTDS have collected samples for each entry point between June 2000 and December 8, 2003; or,
- Systems collect data from a representative point in the distribution system between June 2000 and December 8, 2003. The State must make a written finding that the data are representative of each entry point based on the variability of historical contaminant monitoring results and other factors listed in the special primacy section of the State Primacy Program application (40 CFR 141.26(a)(2)(ii)).

EPA is encouraging States to have systems monitor for uranium before the effective date of The Radionuclides Rule. A system that samples for uranium before December 8, 2003 and has a sampling result:

- Less than the 30 µg/L MCL, can grandfather the data if the State permits it.

ILLUSTRATION I-7
Use of Grandfathered Data to Satisfy the Initial Monitoring Requirements

A system with one EPTDS has collected gross alpha samples for the two previous compliance periods (1992-1996 and 1996-2000). The State tells the system that if it collects samples at the EPTDS for gross alpha, radium-226, radium-228, and uranium between June 2000 and December 8, 2003 it may be able to grandfather this data and will therefore not be subject to the initial quarterly monitoring requirements when the new Rule goes into effect. The system collects the samples during 2002 and finds concentrations of: 5piC/L for gross alpha, 2piC/L for radium-226, 3piC/L for radium-228, and does not detect uranium.

The State uses these data to set a compliance schedule of:

- One sample every 6 years for gross alpha since the result was greater than the detection level but less than one-half the MCL. The system would have to take the next sample between 2008 and 2013.
- One sample every 3 years for combined radium-226/228 since the combined result (2piC/L + 3piC/L) is greater than one-half the MCL but less than or equal to the MCL. The system must take the next sample between 2008 and 2010.
- One sample every 9 years for uranium since the sample was less than the regulatory detection limit. The system must take the next sample between 2008

- Greater than or equal 30 µg/L, must, when directed by the State, take four consecutive quarterly samples during the initial monitoring period. Even though the system has sampling results above the MCL, the system will not be in violation of the uranium standard on the effective date of the Rule (December 8, 2003). However, EPA is encouraging systems that have high levels of uranium to initiate plans to resolve the public health risk.

Systems are prohibited from using grandfathered data to satisfy the monitoring requirements for beta particle and photon radioactivity. This prohibition was established in the 1976 Radionuclides Rule and the revised Radionuclides Rule does not deviate from this standard (40 CFR 141.26(b)).

I-C.6 Monitoring Waivers

A State cannot allow a system to forego initial or reduced monitoring (40 CFR 141.26). A State has the authority to waive the final two quarters of initial monitoring for a sampling point if the results of the samples from the two previous quarters are below the detection limit.

The State cannot allow a system to forego monitoring of beta and photon emitters if the system has been designated as "vulnerable" or "contaminated."

I-C.7 Requirements for New Systems/Sources

New CWSs and systems that begin using a new source of supply must conduct monitoring for gross alpha, radium-226/228, and uranium. (Systems have to collect sample(s) for uranium only if the gross alpha level is greater than 15 pCi/L.) In accordance with the initial monitoring requirements, this monitoring must begin within the first quarter after initiating use of the new source (40 CFR 141.26(a)(1)(ii)). New systems or systems using a new source of supply may also have to sample for beta particle and photon radioactivity if required by the State. Figure I-4 in Appendix A is a flowchart that summarizes the monitoring requirements for new systems and sources.

States may require new PWSs, systems that bring on new water sources, or systems that have no prior history of radionuclide monitoring to develop an occurrence profile (i.e. collect one sample of gross alpha, radium-226, and radium-228) to determine if it is necessary to monitor for uranium. States can also use the profile to determine for which radionuclides the system must monitor during the initial monitoring period. All new systems must collect samples in accordance with the monitoring requirements outlined in Section I.C.4 of this document. (See Illustration I-8[8]).

ILLUSTRATION I-8
New System Monitoring

A water system that commences operation in 2004 collects its first quarterly sample for gross alpha, radium-226, and radium-228. The results are:
Gross alpha = 1pCi/L
Radium-226 = 0.5 pCi/L
Radium-228 = no detect

The system decides to collect only radium-228 and gross alpha in the remaining quarterly samples and substitute the gross alpha results for radium-226 and uranium.

The results for the next three quarters are all below the detection limit for gross alpha and radium-228. The State allows the system to reduce the monitoring frequency for gross alpha and uranium to one sample every 9 years and one sample every 6 years for combined radium-

[8]For additional illustrations and examples, please see Appendix E: SDWIS-FED DTF Reporting Requirements Guidance.

I-C.8 Monitoring for Beta Particle and Photon Radioactivity

This section presents the initial, reduced, and increased monitoring requirements for the beta particle and photon radioactivity. Only CWSs designated by the State as "vulnerable" or "contaminated" need to monitor for beta particle and photon radioactivity. EPA believes that the State is in the best position to determine which systems are vulnerable to, or contaminated by, beta and photon emitters. States should use existing vulnerability assessments (required under the 1976 Radionuclides Rule) to notify systems of their status (i.e., vulnerable or contaminated) and of the monitoring requirements. Figure I-4 in Appendix A summarizes the beta particle and photon radioactivity monitoring requirements.

EPA is encouraging States to re-evaluate a system's vulnerability to beta particle and photon emitting sources when conducting a system's source water assessment (SWA) and to immediately notify systems that have been deemed vulnerable or contaminated. When using a SWA as a tool for identifying vulnerable systems, the time of travel for radioactive emitters that may be identified in the source area should be a minimum of 3 years. The Agency recommends that States use all available resources to determine a systems vulnerability to beta particle and photon emitters including the following:

- Evaluation of the quality and completeness of any historical beta particle and photon emitter monitoring results and the proximity of the results to the MCL. Systems with wide variations in the analytical results, or analytical results close to the MCL should be considered a system contaminated by a radioactive source.

- Nuclear Regulatory Commissions list of licensees and location in the State and surrounding States (The State may want to eliminate facilities that only handle sealed sources of radioactive material).

- Geology of the aquifer and/or hydrology of the watershed.

- The location and proximity of the drinking water facility to (list is not all inclusive):

  - Nuclear power facilities;

  - Department of energy facilities;

  - Military bases (Department of Defense facilities);

  - National priority list facilities that have been identified as radiation contaminated sites through the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); and,

  - Leaking landfills.

I-C.8.a Initial Monitoring for Beta Particle and Photon Radioactivity

The Radionuclides Rule requires systems to monitor for beta particle and photon radioactivity under the following circumstances:

- The system is designated by the State as vulnerable;

- The system is designated by the State as utilizing waters contaminated by effluents from nuclear facilities; or,

- The State, at its own discretion, requires the system to collect samples (40 CFR 141.26(b)).

Vulnerable systems must collect quarterly samples for beta emitters and annual samples for tritium and strontium-90 at each EPTDS (40 CFR 141.26(b)(1)). Sampling must begin during the quarter following the quarter in which the system is notified by the State. (See Figure I-4 in Appendix A.)

Systems designated by the State as utilizing waters contaminated by effluents from nuclear facilities must also collect quarterly samples for beta emitters and iodine-131, and annual samples for tritium and strontium-90 at each EPTDS (40 CFR 141.26(b)(2)). More frequent monitoring is required if iodine-131 is found in finished water (40 CFR 141.26(b)(2)(ii)). Sampling must begin during the quarter following the quarter in which the system is notified by the State. (See Figure I-4 in Appendix A.)

For the quarterly monitoring requirements for gross beta particle activity, samples must be collected monthly and analyzed or composited and analyzed (40 CFR 141.26(b)(2)(i)). For the quarterly monitoring requirements for iodine-131, samples must be collected for 5 consecutive days, composited, and analyzed (40 CFR 141.26(b)(2)(ii)).

For the annual monitoring requirements for tritium and strontium-90, samples must be collected quarterly and analyzed or composited and analyzed (40 CFR 141.26(b)(2)(iii)). In all cases, laboratories are responsible for compositing the samples prior to analysis.

I-C.8.b Reduced Monitoring for Beta Particle and Photon Radioactivity

A State may allow a system to reduce the frequency of monitoring to once every 3 years if:

- In a vulnerable system, the gross beta particle activity minus the naturally occurring potassium-40 beta particle activity has a running annual average (computed quarterly) less than or equal to 50 pCi/L (40 CFR 141.26(b)(1)(i)).

- In a system designated by the State as utilizing waters contaminated by effluents from nuclear facilities, the gross beta particle activity minus the naturally occurring potassium-40 beta particle activity has a running annual average (computed quarterly) less than or equal to 15pCi/L (40 CFR 141.26(b)(2)(iv)).

I-C.8.c Increased Monitoring for Beta Particle and Photon Radioactivity

A system that exceeds the gross beta particle activity screening level, excluding the naturally occurring potassium-40, must further analyze the sample for the major radioactive constituents[9] (40 CFR 141.26(b)(5)). The beta particle screening levels are 50 pCi/L for systems determined by the State to be vulnerable to contamination and 15 pCi/L for systems utilizing waters contaminated by effluents from nuclear facilities. The system must determine compliance with the MCLs for beta particle and photon radioactivity by using the calculation described in 40 CFR 141.66(d)(2). (See also Section II-B.2.)

[9]A State will require a system to speciate the sample for the most likely emitters associated with the nearby source.

If the results show an MCL violation for any of the constituents, the system must conduct monthly monitoring at any sampling point that exceeds the MCL beginning the month after the exceedance occurs. A system can resume quarterly monitoring if the rolling average of 3 months of samples is at or below the MCL (40 CFR 141.26(b)(6)).

I-C.8.d Use of Environmental Surveillance Data for Beta Particle and Photon Radioactivity Measurements

States that allow systems to use environmental surveillance data collected by a nuclear facility in lieu of the water system's required beta particle and photon radioactivity monitoring should review the data to determine if they are applicable to the water system. If the surveillance data indicate that there has been a release, systems must begin collecting quarterly samples for beta particle and photon radioactivity at each EPTDS (40 CFR 141.26(b)(1)(ii) and 141.26(b)(2)(v)).

Table I-5: Monitoring Frequencies for Beta Particle and Photon Radioactivity

<table>
<tr><th>Initial
40 CFR 141.26(b)(1) & (b)(2)</th><th colspan="2">Reduced
40 CFR 141.26(b)(1)(i) & (b)(2)(iv)</th></tr>
<tr><td colspan="3">BETA PARTICLE AND PHOTON RADIOACTIVITY</td></tr>
<tr><td>Vulnerable CWSs (as designated by the State): Quarterly samples for beta emitters and annual samples for tritium and strontium-90 at each entry point, within one quarter after being notified by the State. Already designated systems must continue to sample in accordance with the compliance schedule (40 CFR 141.26(b)(1)).</td><td rowspan="2">One sample every:</td><td>Three years if the gross beta particle activity minus the naturally occurring potassium-40 beta particle activity has a running annual average less than or equal to the screening level of 50 pCi/L (40 CFR 141.26(b)(1)(i)).</td></tr>
<tr><td>CWSs utilizing waters contaminated by effluents from nuclear facilities (as designated by the State): Quarterly samples for beta emitters and iodine-131 and annual samples for tritium and strontium-90 at each entry point, within one quarter of being notified by the State. Already designated systems must continue to sample in accordance with the compliance schedule (40 CFR 141.26(b)(2)).</td><td>Three years if the gross beta particle activity minus the naturally occurring potassium-40 beta particle activity has a running annual average less than or equal to the screening level of 15 pCi/L (40 CFR 141.26(b)(2)(iv)).</td></tr>
</table>

I-C.9 Laboratory Methods

This section summarizes the testing procedures that have been approved by EPA to provide reliable compliance monitoring of radionuclides in drinking water.

I-C.9.a Radionuclides Methods

In 1976, EPA published interim standards for radionuclides in drinking water and approved radiochemical methods to analyze for gross alpha-particle activity, radium-226, total gross radium alpha, gross beta-particle activity, strontium-89 and strontium-90, cesium-134, and uranium. These interim standards were declared to be final National Primary Drinking Water Regulations in the 1986 SDWA Amendments.

On July 18, 1991, EPA proposed to approve 56 additional methods to measure radionuclides (excluding radon) in drinking water(56 FR 33050). EPA approved 54 of the 56 methods in the March 5, 1997 final methods rule (62 FR 10168). In response to public comments on the 1991 proposed rule, EPA evaluated and approved an additional 12 techniques. In total, EPA approved 66 radiochemical methods on March 5, 1997 (62 FR 10168). Currently, approximately 90 radiochemical methods are approved for compliance monitoring of radionuclides in drinking water.

The approved radionuclide methods are listed in 40 CFR 141.25. EPA's laboratory certification manual describes each method's quality control requirements for sample handling, preservation, holding times, and instrumentation (EPA 815-B-97-001).

I-C.9.b Updates Regarding Analytical Techniques

EPA is currently reviewing :

- The use of an Inductively Coupled Plasma Mass Spectrometry (ICP-MS) method for uranium analysis.

- The feasibility of using Gamma Spectrometry for radium-228 analysis.

I-C.9.c Externalization of the Performance Evaluation Program

On July 18, 1996, EPA proposed options for the externalization of the Performance Evaluation (PE) studies program (now referred to as the Proficiency Testing or PT program) (61 FR 37464). EPA issued a final notice on June 12, 1997 after evaluating public comment. The Agency

> *"...decided on a program where EPA would issue standards for the operation of the program, the National Institute of Standards and Technology (NIST) would develop standards for private sector PE* (PT) *suppliers and would evaluate and accredit PE suppliers, and the private sector would develop and manufacture PE* (PT) *materials and conduct PE* (PT) *studies. In addition, as part of the program, the PE* (PT) *providers would report the results of the studies to the study participants and to those organizations that have responsibility for administering programs supported by the studies"* (62 FR 32112).

The PT externalization may affect the implementation of the Radionuclides Rule by causing a short-term disruption in laboratory accreditation, laboratory capacity, cost of analysis, and workloads of laboratories. To alleviate concerns about the costs of PT samples, States have the option of approving their own PT sample providers that can be used instead of the independent third-party provider who will be accredited by the National Institute of Science and Technology (NIST). EPA anticipates that radionuclide PT samples will be available in time to allow for laboratory certification before compliance monitoring is required.

To alleviate concerns about potential laboratory capacity problems, EPA extended the initial monitoring period from 3 to 4 years so that it would end on December 31, 2007. Also, EPA is allowing systems to grandfather and composite data under certain circumstances. In addition, EPA **is not** requiring NTNCWSs to monitor for radionuclides and **is not** requiring a 48-to-72 hour turn around for gross alpha particle activity.

I-C.9.d The Detection Limits as the Required Measures of Sensitivity

In 1976, the National Primary Drinking Water Regulations defined the *detection limit* (DL) as "the concentration which can be counted with a precision of plus or minus 100 percent at the 95 percent confidence level (1.96 σ, where σ is the standard deviation of the net counting rate of the sample)" (40 CFR 141.25(c)).

EPA maintained the DLs from the 1976 rule. Table I-6 cites the DLs or the required sensitivity for the specific radioanalyses that were listed in the 1976 rule and are also cited in 40 CFR 141.25.

Table I-6: Required Regulatory Detection Limits for the Various Radionuclide Emitters (40 CFR 141.25)

Contaminant	Detection Limit (pCi/L)
Gross Alpha	3
Gross Beta	4
Radium-226	1
Radium-228	1
Uranium	To be determined[10]
Cesium-134	10
Strontium-89	10
Strontium-90	2
Iodine-131	1
Tritium	1,000
Other Radionuclides	1/10th of the applicable limit

I-C.10 Treatment Technologies and Cost Estimates

When promulgating an MCL, EPA must list:

- **Best Available Technologies (BATs).** The technologies, treatments, and techniques listed in the Radionuclides Rule (40 CFR 141.66(g)) were determined by EPA to be the BATs for the removal of radionuclides in drinking water based on a demonstration of efficacy under field condition taking cost into consideration. Table I-7, below, lists the BATs identified by EPA. EPA evaluated "Technologies and Costs" for radionuclides in drinking water in 1992. The evaluations were updated in a Technologies and Costs (T&C) draft (1999) and a radium compliance cost study (1998).

[10]A DL for uranium is not listed in 40 CFR 141.25 and none was proposed in the 1991 proposal. EPA did propose a PQL and an acceptance limit but in order to be consistent with other regulated radionuclides, is not adopting the PQL. The Agency will propose a detection limit for uranium in future rulemaking and will set the limit before December 8, 2003 (the compliance date for the Rule).

Table I-7: BATs for Radionuclides in Drinking Water

Contaminant	BAT
Combined radium-226 and radium-228	Ion Exchange, Lime Softening, Reverse Osmosis
Gross alpha (excluding radon and uranium)	Reverse Osmosis
Beta particle and photon radioactivity	Ion Exchange and Reverse Osmosis
Uranium	Ion Exchange, Lime Softening; Reverse Osmosis, Enhanced Coagulation/Filtration*

* This assumes that a system already has coagulation/filtration in place.

Systems are not required to use BATs to achieve compliance with the MCL. Any technology that is accepted by the State primacy agency and achieves compliance with the MCL is allowed. However, if a system is unable to meet the MCL with its chosen technology, the system is not eligible for a variance unless it has installed a BAT and still cannot achieve compliance. For more information on variances and exemptions, see Section I-C.11 below.

- **Small System Compliance Technologies (SSCTs).** The technologies examined for BAT determinations were also evaluated as SSCTs. EPA must list SSCTs for three sizes of small systems: systems serving between 25 and 500 persons, systems serving between 501 and 3,300 persons, and systems serving between 3,301 and 10,000 persons. The listed SSCTs are affordable for small systems and will achieve compliance with the MCL. For more information on SSCTs, see Section I-A.10.b below.

  Because EPA has listed SSCTs, small systems:

  — Will have the latitude to choose the type of treatment technology that is most cost effective and appropriate (from an operation and maintenance standpoint).

  — Are not eligible for *small system variance*s since there are affordable technologies that will achieve compliance with the MCLs. (See Section I-A.11.b.)

  — May be eligible for a variance if it has installed, or agreed to install the BAT or SSCT but, due to source water quality, the system will not be in compliance with the MCL. (See Section I-A.11.a below).

  EPA evaluated the BATs, other technologies, and point-of-use (POU) and point-of-entry (POE) devices to determine the SSCTs. POE units treat all of the water entering a household or other building, so that treated water comes from any tap. POU treatment units treat water only at a particular tap or faucet. The result is treated water at that one tap and untreated water at the other taps. POE and POU treatment units often use the same technological concepts employed in the analogous central treatment processes, the main difference being the much smaller scale of the device itself and the flows being treated. (*Small System Compliance Technology Lists for Non-microbial Contaminants Regulated Before 1996.*)

EPA believes that it is feasible for a small system to own, control, and maintain POE/POU devices for radionuclide MCL compliance. However, using POU/POE devices may require more record-keeping than central treatment and may require more frequent monitoring to ensure that the treatment units are operating properly. The compliance agreement between the primacy agency and the system must require monitoring that is as protective as monitoring for a system using centralized treatment, and may not be less frequent than annually for surface water systems and one sample every 3years for ground water systems. The primacy agency can amend the agreement to increase or reduce the monitoring frequency depending on the initial monitoring results.

Table I-8 lists the small system compliance technologies for radionuclides and the limitations of their use. Table I-9 lists the Small Systems Compliance Technologies for the currently regulated radionuclides that are appropriate for the three system size categories designated in the SDWA. The technology numbers refer to the technologies listed in Table I-8.

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Table I-8: List of Small Systems Compliance Technologies for Radionuclides and Limitations of Use

Unit Technologies	Limitations (see footnotes)	Operator Skill Level Required[1]	Raw Water Quality Range & Considerations[1]
1. Ion Exchange (IE)	(a)	Intermediate	All ground waters
2. Point of Use (POU[2]) IE	(b)	Basic	All ground waters
3. Reverse Osmosis (RO)	(c)	Advanced	Surface waters usually require pre-filtration
4. POU[2] RO	(b)	Basic	Surface waters usually require pre-filtration
5. Lime Softening	(d)	Advanced	All waters
6. Green Sand Filtration	(e)	Basic	
7. Co-precipitation with Barium Sulfate	(f)	Intermediate to Advanced	Ground waters with suitable water quality
8. Electrodialysis/Electrodialysis Reversal		Basic to Intermediate	All ground waters
9. Pre-formed Hydrous Manganese Oxide Filtration	(g)	Intermediate	All ground waters

10. Activated alumina	(a), (h)	Advanced	All ground waters; competing a affect regeneration frequency
11. Enhanced Coagulation/filtration	(i)	Advanced	Can treat a wide range of water

[1] National Research Council (NRC). *Safe Water from Every Tap: Improving Water Service to Small Communities*. National Academy Press. Washington, D.C. 1997.

[2] A POU, or "point-of-use" technology is a treatment device installed at a single tap used for the purpose of reducing contaminants in drinking water at that one tap. POU devices are typically installed at the kitchen tap. See the April 21, 2000 NODA for more details.

Limitations Footnotes: Technologies for Radionuclides

[a] The regeneration solution contains high concentrations of the contaminant ions. Disposal options should be carefully considered before choosing this technology.

[b] When POU devices are used for compliance, programs for long-term operation, maintenance, and monitoring must be provided by water utility to ensure proper performance.

[c] Reject water disposal options should be carefully considered before choosing this technology. See other RO limitations described in the SWTR Compliance Technologies Table.

[d] The combination of variable source water quality and the complexity of the water chemistry involved may make this technology too complex for small surface water systems.

[e] Removal efficiencies can vary depending on water quality.

[f] This technology may be very limited in application to small systems. Since the process requires static mixing, detention basins, and filtration, it is most applicable to systems with sufficiently high sulfate levels that already have a suitable filtration treatment train in place

[g] This technology is most applicable to small systems that already have filtration in place.

[h] Handling of chemicals required during regeneration and pH adjustment may be too difficult for small systems without an adequately trained operator.

[i] Assumes modification to a coagulation/filtration process already in place.

Table I-9: Compliance Technologies by System Size Category for Radionuclide NPDWRs (Affordability Not Considered, Except for Uranium, Due to Statutory Limitations)

	Compliance Technologies[1] for System Size Categories (Population Served)		
Contaminant	**25 - 500**	**501 - 3,300**	**3,301 - 10,000**
Combined radium-226 and radium-228	1, 2, 3, 4, 5, 6, 7, 8, 9	1, 2, 3, 4, 5, 6, 7, 8, 9	1, 2, 3, 4, 5, 6, 7, 8, 9
Gross alpha particle activity	3, 4	3, 4	3, 4
Beta particle activity and photon activity	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4
Uranium	1, 2, 4, 10, 11	1, 2, 3, 4, 5, 10, 11	1, 2, 3, 4, 5, 10, 11

Note: (1) Numbers correspond to those technologies found listed in the Table I-8

I-C.10.a Waste Treatment, Handling and Disposal Guidance

EPA has developed guidance for system managers, engineers, and State agencies responsible for the safe handling and disposal of treatment wastes that, in many cases, are not specifically addressed by any statute ("Suggested Guidelines for Disposal of Drinking Water Treatment Wastes Containing Naturally-Occurring Radionuclides," EPA 1994, Updated November 2000. The guidelines will be posted on http://www.epa.gov). The guidance provides information on the following:

- Background on water treatment processes and characteristics of wastes generated;
- Rationale for radiation protection, including citation of programs and regulations affecting other sources of such waste;
- Guidelines for several methods of disposal of solid and liquid type wastes containing the subject radionuclides; and,
- The specification of practical guidance to protect workers and others who may handle or be exposed to water-treatment wastes containing radiation above background levels.

I-C.10.b Technology Cost Estimates

In accordance with Federal rulemaking process, EPA estimated the costs and benefits of the changes to the 1976 Radionuclides Rule by preparing an *Economic Analysis of the Radionuclides National Primary Drinking Water Regulations* (November 2000). The Economic Analysis was an update to the Health Risk Reduction and Cost Analysis announced in the NODA.

States and systems are expected to incur costs for two requirements under the Radionuclides rule: compliance with the uranium MCL and individually monitoring for radium 228. EPA estimates that these requirements will result in annual compliance costs of $81 million and State implementation costs of $0.6 million.[11] Table I-10 shows a breakdown of expected compliance costs.

Table I-10: Summary of Cost Estimates

	Numbers of systems impacted (population exposed above MCL)[1]	**Best-estimate of annual compliance costs (in millions of $/ year)**
Systems impacted by corrections to the monitoring deficiencies for combined radium-226 and -228		
Eliminate combined radium monitoring	295 systems (420,000 persons)	$25
Systems predicted to be out of compliance with proposed options for uranium MCL		
Uranium at 30 g/L	500 systems (620,000 persons)	$51

Notes: Compliance costs do not include monitoring and reporting costs, which comprise an additional $5 million annually. Ranges based on directly proportional versus lognormal distribution approach.
1. Compared to the initial baseline (i.e., occurrence data are adjusted to eliminate existing MCL violations) for combined radium. Occurrence data is unadjusted for uranium options.

I-C.11 Variances and Exemptions

I-C.11.a Variances

If a system can not meet MCLs because of the characteristics of its raw water sources, it may be eligible for a variance under SDWA 1415(a) on condition that:

[11] All cost estimates are in 1999 dollars.

- The system install a BAT (all system sizes), an SSCT (systems serving fewer than 3,300 persons), or other means as determined by EPA; and,

- A State evaluation indicates that alternative sources of water are not reasonably available.

While a variance may allow a system to provide water that exceeds the MCL, it will only be granted if the quality of the water delivered under the variance will not result in an unreasonable risk to health.

Eligibility for a variance from the MCLs for gross alpha, combined radium-226/228, uranium, and beta and particle and photon emitters requires that the system install, operate, and maintain a technology specified in the final Radionuclides Rule and enter into a compliance schedule with the primacy agency.

I-C.11.b Exemptions

While the primacy agency may grant exemptions from MCLs and/or treatment technique requirements in NPDWRs as provided for under SDWA 1416, these exemptions may only extend the applicable compliance date 3 years.[12] Since the MCLs for gross alpha, radium 226/228, and total beta particle and photon emitters were promulgated in 1976, no more exemptions may be granted.

However, exemptions may be granted from the MCL for uranium if:

- Due to compelling factors the PWS is unable to comply with the MCL or implement measures to develop an alterative source of water supply;

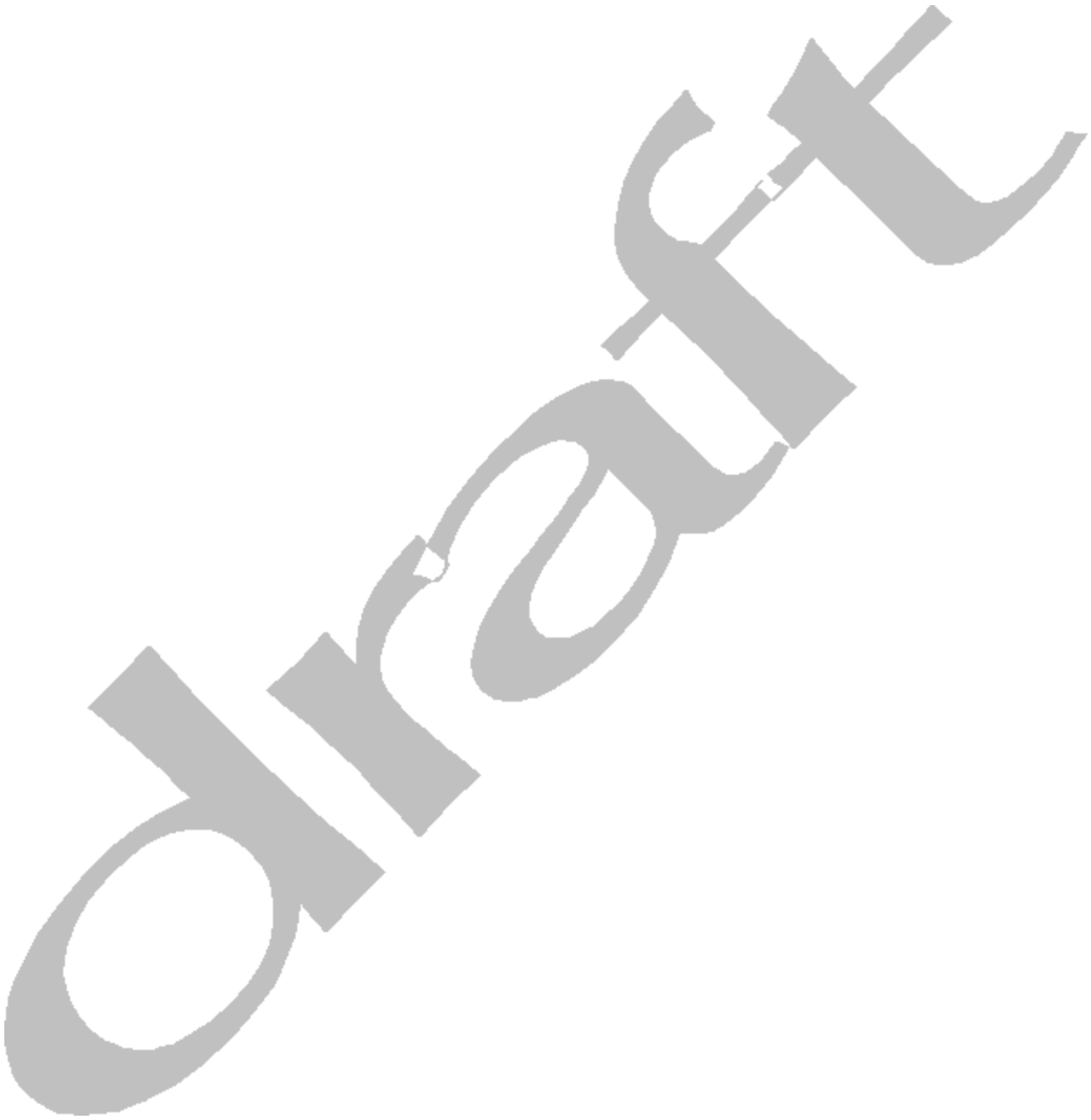
- The PWS was in operation on December 2003 or if the system was not operating by this date, no reasonable alternative source of drinking water is available;

- The exemption will not result in an unreasonable risk to public health; and,

- Management and restructuring changes can not reasonably be made to lead to MCL compliance or improve the quality of water.

Exemptions from the uranium MCL may be granted to systems of all sizes. When granting an exemption, the State must issue a schedule requiring compliance as expeditiously as practicable but no later than December 8, 2006.

[12] In the case of a system that serves 3,300 persons or fewer or needs financial assistance for improvements, additional exemptions totalling no more than 6 years may be granted.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Section II.

SDWIS Reporting, Violation Determination, and SNC Definitions

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II-A. SDWIS Reporting

Table II-1 summarizes the Safe Drinking Water Information System/Federal (SDWIS/FED) reporting requirements for the Revised Radionuclides Final Rule. The summary contains SDWIS/FED violation and contaminant codes.

This table lists only potential federal violations. Appendix E provides SDWIS/FED DTF reporting guidance on how to place these violations in the appropriate structure so that SDWIS/FED can accept them, when reported.

Table II-1: Revised Radionuclides Final Rule Federal Reporting Violations

Contaminant Code	Contaminant	Violation
4000	Gross Alpha	02, 03, 08
4010	Combined Radium (-226 &-228)	02, 03, 08
4006	Combined Uranium	02, 03, 08
4100	Gross Beta Particle Activity	02, 03, 08
4102	Tritium	03, 08
4174	Strontium-90	03, 08
4264	Iodine-131	03, 08

Note: Violation Types and Definitions
- 02 - MCL, Average
- 03 - Failure to Monitor/Report
- 08 - Variance/Exemption/Other Compliance Schedule

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II-B. Violation Determination

II-B.1 Violation/Compliance Determination for Gross Alpha, Radium-226/228, and Uranium

States must determine compliance based on the analytical result(s) obtained at each EPTDS (40 CFR 141.26(c)(3)). A system is in violation if:

- Any sampling point is in violation of an MCL (40 CFR 141.26(c)(3)).
- Any sample result will cause the running annual average to exceed the MCL at any EPTDS (i.e., the analytical result is greater than four times the MCL).

For systems monitoring more than once per year, compliance with the MCL is determined by a running annual average at each sampling point. Systems that monitor annually or less frequently and whose sample result exceeds the MCL must revert to quarterly sampling for that contaminant during the next quarter. Systems are required to conduct quarterly monitoring only at the EPTDS at which the sample was collected and for the specific contaminant that triggered the system into the increased monitoring frequency. Systems triggered into increased monitoring will not be considered in violation of the MCL until they have completed 1-year of quarterly sampling. (40 CFR 141.26(c)(3)).

If a system does not collect all required samples when compliance is based on a running annual average of quarterly samples, compliance will be based on the running annual average of the samples collected. If a sample result is less than the method detection limit, zero will be used to calculate the annual average. However, if a gross alpha particle activity result is being used in lieu of radium-226 or uranium, then half the detection limit will be used to calculate the annual average. States have the discretion to delete results of obvious sampling or analytic errors.

States still have the flexibility to require confirmation samples for positive or negative results.[13] States may require more than one confirmation sample to determine the average exposure over a 3-month period. Confirmation samples must be averaged with the original analytical result to calculate an average over the 3-month period. The 3-month average must be used as one of the quarterly concentrations for determining the running annual average. The running annual average must be used for compliance determinations (40 CFR 141.26(c)(1)).

The Rule requires that monitoring be conducted at all entry points to the distribution system. However, the State can require monitoring and determine compliance based on a case-by-case analysis of individual drinking water systems. EPA encourages drinking water systems to inform State regulators of their individual circumstances. Some systems have implemented elaborate plans including targeted, increased monitoring that is much more representative of the average annual mean contaminant concentration to which individuals are being exposed. (Some States determine compliance based on a time-or-flow weighted average.) In many cases, the State can demonstrate that compliance is being calculated based on scientific methods that are more representative of the true contaminate concentration to which individuals are being exposed over a year, but it substantially increases the sampling and analytical costs. Some States require that systems collect samples from wells that operate for only one month out of the year regardless of whether they are operating during scheduled sampling times. The State may determine

[13] At a State's discretion, a system may be required to take additional samples to confirm sampling results.

compliance based on several factors including the quantity of water supplied by a source, the duration of service of the source, and contaminant concentration.

II-B.2 Violation/Compliance Determination for Gross Beta and Photon Emitters

The Radionuclides Rule uses a "sum-of-the-fractions" method to determine whether a system is in compliance with the MCL for beta particle and photon radioactivity (40 CFR 141.66(d)). This method is used because each photon emitter targets a different organ of the body, which results in a different magnitude of risk. The sum of the beta and photon emitters shall not exceed 4 millirems/year (40 CFR 141.66(d)(2)).

While the measure used in risk calculations is "millirems," contaminants are analyzed in "pCi/L." Therefore, to determine compliance, each beta and photon emitter must be converted from pCi/L to millirems using the conversion tables listed in "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air or Water for Occupational Exposure" (NBS Handbook 69 as amended August, 1963, U.S. Department of Commerce). (See Appendix I for the conversion tables.)

The column titled "1976 limits based on critical organ at 4 mrem/yr" indicates what 4 mrem of exposure would be for that contaminant expressed as pCi/L. For each emitter that is detected by the laboratory, the system must divide the pCi/L found in the sample by the value in the conversion tables. This provides a fraction of how much the particular beta or photon emitter is providing towards the maximum of 4 mrem/yr for all of the beta photon emitters.

$$\frac{\text{pCi/L found in sample (from laboratory results)}}{\text{pCi/L equivalent of 4 mrem of exposure (from conversion table)}} = \text{fraction of the maximum 4 mrem/year exposure limit}$$

Each fraction must then be converted to a dose equivalent of 4 mrem/yr by multiplying the fraction by 4. The results for each emitter must be summed to determine compliance. (See Illustration II-1.)

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ILLUSTRATION II-1
Conversion of Beta Particle and Photon Emitters

A water system near a nuclear power facility collects a sample which the laboratory speciates by EPA method 902.0 (gamma spectrometry analysis). The laboratory also analyses for strontium-90 using EPA method 905.0. The analysis indicates the following:

Cesium-134 (Cs-134):	5,023 pCi/L
Cesium-137 (Cs-137):	30 pCi/L
Strontium-90 (Sr-90):	4 pCi/L
Iodine-131 (I-131):	2 pCi/L

To determine compliance the following calculations are completed:

Emitter	**(X)** **Lab Analysis (pCi/L)**	**(Y)** **Conversion from table (pCi/4mrem)**	**(X/Y=A)** **Calculated Fraction[1]**	**(A*4)** **Calculated Total mrem[2]**
Cs-134	5,023	20,000	0.25115	1
I-131	2	3	0.7	3
Cs-137	30	200	0.150	0.6
Sr-90	4	8	0.5	2
Sum-of-the-fractions				7

[1]To ensure accuracy, the results were rounded to the number of figures in the conversion table. See Appendix I.

[2]Since data reported to the State or EPA should be in a form containing the same number of significant digits as the MCL, the results were rounded to one significant digit. The last significant digit was increased by one unit if the digit dropped was a 5, 6, 7, 8, or 9; and was not altered if the preceding number was a 0, 1, 2, 3, or 4.

The system is in violation of the MCL because the "sum-of-the-fractions" is 7 mrem, which means that the sum of the annual dose equivalent to the total body, or to any internal organ, exceeds 4 mrems/yr.

II-C. SNC Definitions

The significant non-compliance (SNC) definition is part of a three-leveled prioritization scheme for all violators of the NPDWRs and is applicable to the final Radionuclides Rule. The definition has been taken from an EPA Memorandum dated May 22, 1990. Level 1 is composed of the SNCs — those violators who present the greatest risk to health — and are therefore, primary enforcement targets.

> "A Radiological SNC is a PWS which meets any of the following Level 1 criteria:
>
> (a) Exceeds the unreasonable risk to health level identified for that contaminant. The unreasonable health level is 2 times the MCL.
>
> (b) Fails to monitor for or report the results of any of the currently regulated contaminants for two consecutive compliance periods if they monitor more than once a year, or failure to monitor or report results once if they monitor once a year or less."

The Level 1, subpart(b) SNC definition previously stated that systems which, "fail to monitor for or report the results of any of the currently regulated contaminants for two consecutive compliance periods" are SNCs. However, the criteria have been slightly modified to prevent water systems on a reduced monitoring schedule from being able to avoid monitoring for up to 18 years before becoming a SNC.

Level 2 represents an intermediate set of violators. Some of these are in violation of an MCL, but the level of the contaminant is sufficiently low that it does not pose an immediate threat to public health.

> "A Level 2 violator is a PWS which meets any of the following criteria:
>
> (a) All violations of the radiological MCLs where the concentration of the contaminant does not exceed the unreasonable risk to health level.
>
> (b) Any monitoring/reporting violation."

Level 3 contains the rest of the violators of the NPDWRs.[14] A Level 3 Violation is not applicable to radiological contaminants, because all violations of radiological MCLs and/or monitoring and reporting requirements begin as Level 2 violations.

[14]The tiered scheme described in this section applies to systems in significant violation of an NPDWR. The tiered system required under the public notification rule applies to all systems.

Section III.

Primacy Revision Applications

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III-A. State Primacy Program Revision

40 CFR Part 142 sets out requirements for States to obtain or retain primary enforcement responsibility (primacy) for the Public Water System Supervision (PWSS) program as authorized by SDWA 1413. The 1996 SDWA Amendments update the process for States to obtain or retain primacy. On April 28, 1998, EPA promulgated the Primacy Rule to reflect these statutory changes (63 FR 23361).

Pursuant to 40 CFR 142.12, complete and final requests for approval of program revisions to adopt new or revised EPA regulations must be submitted to the Administrator no later than 2 years after promulgation of the new or revised federal regulations (see Table III-1). Until those applications are approved, EPA Regions have responsibility for directly implementing The Radionuclides Rule. The State and EPA can agree to implement the Rule together during this period. EPA anticipates that, for The Radionuclides Rule, those responsibilities will involve only outreach to ensure that systems desiring flexibility for initial monitoring are able to grandfather appropriate data. However, if a State is eligible for interim primacy, once it submits a complete and final revision package, it will have full implementation and enforcement authority. A State may be granted an extension of up to 2 years to submit its application package. During any extension period, an agreement outlining the State's and EPA's responsibilities is required.

Table III-1: State Rule Implementation and Revision Timetable for Radionuclides Rule

EPA/State Action	Time Frame
Rule published by EPA	December 7, 2000
State and Region establish a process and agree upon a schedule for application review and approval	May 2001
State, at its option, submits *draft* program revision package including: Preliminary Approval Request Draft State Regulations and/or Statutes Regulation Crosswalk	September 2001 (Suggested)
EPA Regional office (and Headquarters, if necessary) review draft	Completed within 90 days of State submittal of Draft
State submits final program revision package including: Adopted State Regulations Regulation Crosswalk 40 *CFR* 142.10 Primacy Update Checklist 40 *CFR* 142.14 and 142.15 Reporting and Recordkeeping 40 *CFR* 142.16 Special Primacy Requirements Attorney General's Enforceability Certification	by September 8, 2002*
EPA conducts final review of State submittal: Regional review (program and ORC) Headquarters concurrence and waivers (OGWDW, OECA, OGC) Public Notice Opportunity for hearing EPA's Determination	Completed within 90 days of State submittal of final 45 days Region 45 days Headquarters
Rule Effective Date	December 8, 2003

* EPA suggests submitting an application by September 2002, to ensure timely approval. EPA regulations allow until December 8, 2002 for this submittal. An extension of up to 2 additional years may be requested by the State.

III-A.1 The Revision Process

The approval of State program revisions is recommended to be a two-step process comprising the submission of a draft request (optional) followed by the submission of a complete and final request for program approval. Figure III-1 diagrams these processes and their timing.

Draft Request — A State may submit a draft request for EPA review and tentative determination. The request should contain drafts of all required primacy application materials. A draft request should be submitted within 9 months after Rule promulgation. EPA will make a tentative determination on whether the State program meets the applicable requirements. The tentative determination should be made within 90 days.

Complete and Final Request — This submission must be in accordance with 40 CFR 142.12(c)(1) and (2) and include the Attorney General's statement. The State should also include its response to any comments or program deficiencies identified in the tentative determination (if applicable). EPA Regions should make States aware that submission of only a final request may make it more difficult for the States to address any necessary changes within the time available for State rule adoption.

EPA requests that States submit their complete and final revision package within 21 months of Rule promulgation. This will ensure that States will have interim primacy within 24 months and will prevent States from becoming backlogged with revision applications to adopt future federal requirements.

The State and EPA Region should agree to a plan and timetable for submitting the State primacy revision application as soon as possible after rule promulgation—ideally within 5 months after promulgation.

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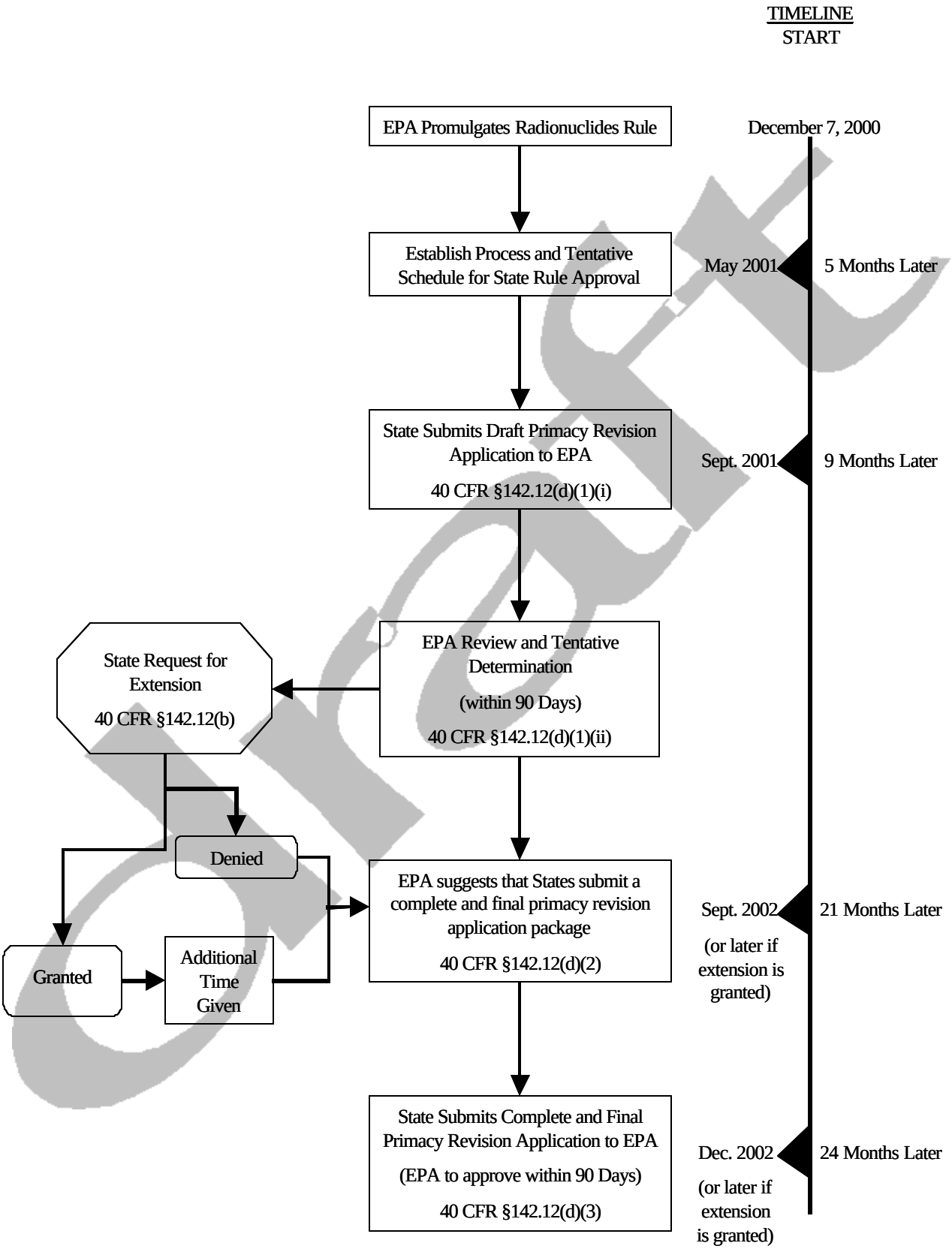
Figure III-1: Recommended Review Process for State Request for Approval of Program Revisions



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III-A.2 The Final Review Process

Once a State application is complete and final, EPA has a regulatory (and statutory) deadline of 90 days to review and approve or disapprove of the revised program. The Office of Ground Water and Drinking Water (OGWDW) will conduct detailed reviews of the first State package from each Region. We ask that the Region submit its comments with the State's package for Headquarters review. Where the Region has identified all significant issues, OGWDW will waive concurrence on all other State programs in that Region, although they will retain the option to review additional State programs with cause. The Office of General Counsel (OGC) and the Office of Enforcement and Compliance (OECA) has delegated its review and approval to the Office of Regional Counsel (ORC).

To meet the 90-day deadline for packages undergoing Headquarters review, the review period will be equally split giving both the Regions and Headquarters 45 days to conduct their respective reviews. For the first package in each Region, EPA Regional offices should forward copies of the primacy revision applications to the Drinking Water Protection Division Director in OGWDW, which will take the lead on the review process.

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III-B. State Primacy Program Revision Extensions

III-B.1 The Extension Process

Under 40 CFR 142.12(b), States may ask that the 2-year deadline for submitting the complete and final request for EPA approval of program revisions be extended for up to 2 additional years in certain circumstances. The extension request must be submitted to EPA within 2 years of the date that EPA published the regulation. The Regional Administrator has been delegated authority to approve extension applications: Headquarters concurrence on extensions is not required.

III-B.2 Criteria that an Extension Request Must Meet

For an extension to be granted, the State must demonstrate that it is requesting the extension because it cannot meet the original deadline for reasons beyond its control, despite a good faith effort to do so. A critical part of the extension application is the State's proposed schedule for submitting of its complete and final request for approval of a revised primacy program. The application must also demonstrate at least one of the following:

(i) That the State currently lacks the legislative or regulatory authority to enforce the new or revised requirements; or,

(ii) That the State currently lacks the program capability adequate to implement the new or revised requirements; or,

(iii) That the State is requesting the extension to group two or more program revisions in a single legislative or regulatory action.

In addition, the State must be implementing the EPA requirements to be adopted in its program revision within the scope of its current authority and capabilities.

III-B.3 Conditions of the Extension

To be granted an extension, the State must agree to certain conditions that must be met during the extension period. These conditions will be negotiated by the Region and the State during the extension approval process and decided on a case-by-case basis. The conditions must be included in an extension agreement between the State and the EPA Regional office. Appendix C contains a sample extension agreement.

Conditions of an extension agreement may include:

- Informing PWSs of the new EPA (and upcoming State) requirements and that the Region will be overseeing implementation of the requirements until it approves the State program revisions or until the State submits a complete and final revision package if the State qualifies for interim primacy.

- Collecting, storing, and managing laboratory results, public notices, and other compliance and operation data required by the EPA regulations.

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- Assisting the Region in the development of the technical aspects of enforcement actions and conducting informal follow-up on violations (telephone calls, letters, etc.).

- Providing technical assistance to PWSs.

- For States whose extension is based on a lack of program capability adequate to implement the new requirements, taking steps agreed to by the Region and the State during the extension period to remedy the deficiency.

- Providing the Region with all the information required under 40 CFR 142.15 State reporting.

Table III-2 provides a checklist the Region can use to review State extensions.

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Table III-2: Extension Request Checklist

I. Reason for State Request

_____ Clustering of Program Revisions

_____ Statutory Barrier

_____ Regulatory Barrier

_____ Lack of Program Capability

- _____ Insufficient Resources
- _____ Funding Level
- _____ Staffing
- _____ Lack of Adequately Trained Staff
- _____ Inadequate Procedures, Guidelines, and Policies

_____ Other _____

II. Actions Taken by the State to Justify an Extension

	Schedule Dates (or attachments)
_____ Seeking Increases in Program Resources	_____
_____ Training Existing Personnel/Revising Training Programs	_____
_____ Revising State Regulations or Statutes	_____
_____ Developing Revised/New Procedures, Guidelines, Policies	_____
_____ Other _____	_____
_____	

III. Extension Decision

_____ Extension Request Approved Date: ___/___/___

- _____ Period of Extension Request: ___/___/___ to ___/___/___

_____ Extension Request Denied Date: ___/___/___

- _____ Reason Cited: _____

IV. Conditions of the Extension

During the extension period the State will (check all that apply):

_____ Inform public water systems of the new requirements and the fact that EPA will be overseeing their implementation until the State's program is approved or submitted if the State qualifies for interim primacy

_____ Collect and store laboratory results and other compliance data

_____ Provide technical assistance to public water systems

_____ Provide EPA with the information required under section 142.15 of the primacy rule

_____ Other _____

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III-C. State Primacy Package

The Primacy Revision Application package should consist of the following sections discussed below:

III-C.1 The State Primacy Revision Checklist (40 CFR 142.10)

This section is a checklist of general primacy requirements, taken from 40 CFR 142.10, as shown in Table III-3. In completing this checklist, the State must identify the program elements that it has revised in response to new federal requirements. If an element has been revised the State should indicate a "Yes" answer in the second column next to the list of program elements and should submit appropriate documentation. For elements that need not be revised, the State need only list the citation and date of adoption in the second column. During the application review process, EPA will insert findings and comments in the third column.

Table III-3: State Primacy Revision Checklist

Required Program Elements		Revision to State Program	EPA Findings/Comments
142.10	Primary Enforcement -- Definition of Public Water System*		
142.10(a)	Regulations No Less Stringent		
142.10(b)(1)	Maintain Inventory		
142.10(b)(2)	Sanitary Survey Program		
142.10(b)(3)	Laboratory Certification Program		
142.10(b)(4)	Laboratory Capability		
142.10(b)(5)	Plan Review Program		
142.10(b)(6)(i)	Authority to apply regulations		
142.10(b)(6)(ii)	Authority to sue in courts of competent jurisdiction		
142.10(b)(6)(iii)	Right of Entry		
142.10(b)(6)(iv)	Authority to require records		
142.10(b)(6)(v)	Authority to require public notification		
142.10(b)(6)(vi)	Authority to assess civil and criminal penalties		
142.10(b)(6)(vii)	Authority to Require CWSs to Provide CCRs**		
142.10(c)	Maintenance of Records		
142.10(d)	Variance/Exemption Conditions (if applicable)***		
142.10(e)	Emergency Plans		

Required Program Elements		Revision to State Program	EPA Findings/Comments
142.10(f)	Administrative Penalty Authority*		

* New requirement from the 1996 Amendments. Regulations published in the April 28, 1998 *Federal Register*.
** New regulation published in the August 19, 1998 *Federal Register*.
*** New regulations published in the August 14, 1998 *Federal Register*.

The 1996 SDWA Amendments include new provisions for PWS definition and administrative penalty authority. States must adopt provisions at least as stringent as these new provisions, now codified at 40 CFR 142.2 and 142.10. Failure to revise primacy for these new provisions can affect primacy for the Radionuclides Rule. However, States may still receive interim primacy for The Radionuclides Rule even if they have not yet revised their base program to comply with the new statutory requirements provided that the State has received an extension to adopt these requirements and that this extension period has not expired (up to April 2002 with full extension).

Rule Bundling — States may bundle the primacy revision packages for multiple rules so long as the submittal date (2 years plus 2-year extension) has not lapsed. The Attorney General statement should reference the new requirements.

III-C.2 Text of the State's Regulation

Each primacy application package must include a citation to the applicable State regulation. 40 CFR 142(c)(l)(i).

III-C.3 Primacy Revision Crosswalk

The Primacy Revision Crosswalk, found in Appendix D, should be completed by States to identify their statutory or regulatory provisions that correspond to each Federal requirement. If a State's provisions differ from federal requirements, the State should explain how its requirements are "no less stringent."

III-C.4 State Reporting and Recordkeeping (40 CFR 142.14 and 142.15)

There are no new State recordkeeping requirements (40 CFR 142.14) under The Radionuclides Rule. However, States must continue to comply with existing reporting and recordkeeping requirements that pertain to Radionuclides.

III-C.5 Special Primacy Requirements (40 CFR 142.16)

Section III-D provides guidance on how States may choose to meet each special primacy requirement.

III-C.6 Attorney General's Statement of Enforceability

The complete and final primacy revision application must include an Attorney General statement certifying that the State regulations were duly adopted and are enforceable. The Attorney General's statement should also certify that the State does not have any audit privilege or immunity laws, or if it has such laws, that these laws do not prevent the State from meeting the requirements of SDWA. If a State has submitted this certification with a previous revision package, then it should indicate the date of submittal and the Attorney General need only certify that the status of the audit laws has not changed

since the prior submittal. An example of an Attorney General's statement for The Radionuclides Rule is presented in Table III-5.

III-C.7 Variances and Exemptions

States that want to have the ability to grant general variances or exemptions for uranium under this Rule must also adopt 40 CFR 142.65. (See Section I-C.11 for more information on variances and exemptions.)

Table III-4: Example of Attorney General Statement

Model Language

I hereby certify, pursuant to my authority as (1) and in accordance with the Safe Drinking Water Act as amended, and (2), that in my opinion the laws of the [State / Commonwealth of (3)] [or tribal ordinances of (4)] to carry out the program set forth in the "Program Description" submitted by the (5) have been duly adopted and are enforceable. The specific authorities provided are contained in statutes or regulations that are lawfully adopted at the time this Statement is approved and signed, and will be fully effective by the time the program is approved.

Guidance For States on Audit Privilege and/or Immunity Laws

In order for EPA to properly evaluate the State's request for approval, the State Attorney General or independent legal counsel should certify that the State's environmental audit immunity and/or privilege and immunity law does not affect its ability to meet enforcement and information gathering requirements under the Safe Drinking Water Act. This certification should be reasonably consistent with the wording of the State audit laws and should demonstrate how State program approval criteria are satisfied.

EPA will apply the criteria outlined in its "Statement of Principles" memo issued on February 14, 1997 (see Appendix F) in determining whether States with audit laws have retained adequate enforcement authority for any authorized federal programs. The principles articulated in the guidance are based on the requirements of federal law, specifically the enforcement and compliance and State program approval provisions of environmental statutes and their corresponding regulations. The principles provide that if provisions of State law are ambiguous, it will be important to obtain opinions from the State Attorney General or independent legal counsel interpreting the law as meeting specific federal requirements. If the law cannot be so interpreted, changes to the State law may be necessary to obtain federal program approval. Before submitting a package for approval, States with audit privilege and/or immunity laws should initiate communications with appropriate EPA Regional Offices to identify and discuss the issues raised by the State's audit privilege and/or immunity law.

Model Language

I. **For States with No Audit Privilege and/or Immunity Laws**

Furthermore, I certify that [State / Commonwealth of (3)] has not enacted any environmental audit privilege and/or immunity laws.

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II. **For States with Audit Laws that do Not Apply to the State Agency Administering the Safe Drinking Water Act**

Furthermore, I certify that the environmental [audit privilege and/or immunity law] of the [State / Commonwealth of (3)] does not affect (3) ability to meet enforcement and information gathering requirements under the Safe Drinking Water Act because the [audit privilege and/or immunity law] does not apply to the program set forth in the "Program Description." The Safe Drinking Water Act program set forth in the "Program Description" is administered by (5); the [audit privilege and/or immunity law] does not affect programs implemented by (5), thus the program set forth in the "Program Description" is unaffected by the provisions of [State / Commonwealth of (3)] [audit privilege and/or immunity law].

III. **For States with Audit Privilege and/or Immunity Laws that Worked with EPA to Satisfy Requirements for Federally Authorized, Delegated or Approved Environmental Programs**

Furthermore, I certify that the environmental [audit privilege and/or immunity law] of the [State / Commonwealth of (3)] does not affect (3) ability to meet enforcement and information gathering requirements under the Safe Drinking Water Act because [State / Commonwealth of (3)] has enacted statutory revisions and/or issued a clarifying Attorney General's statement to satisfy requirements for federally authorized, delegated or approved environmental programs.

Seal of Office

_____
Signature

_____
Name and Title

_____
Date

(1) State Attorney General or attorney for the primacy agency if it has independent legal counsel
(2) 40 CFR 142.11(a)(6)(i) for initial primacy applications or 142.12(c)(1)(iii) for primacy program revision applications..
(3) Name of State or Commonwealth
(4) Name of Tribe
(5) Name of Primacy Agency

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III-D. Guidance for Special Primacy Requirements

This section contains guidance States can use when addressing the special primacy requirements of 40 CFR 142.16. It specifically addresses the special primacy conditions added for implementation of The Radionuclides Rule. The guidance addresses special primacy conditions in the order that they occur in the rule.

States should note that, in several sections, the guidance makes suggestions and offers alternatives that go beyond the minimum requirements indicated by reading the subsections of 40 CFR 142.16. EPA does this to provide States with information or suggestions that may be helpful to States' implementation efforts. Such suggestions are prefaced by "may" or "should" and are not required elements of States' applications for program revision.

III-D.1 Special Primacy Requirements

40 CFR 142.16 Special primacy requirements. (l) An application for approval of a State program revision for Radionuclides which adopts the requirements specified in 141.26(a)(2)(ii)(C) must contain the following (in addition to the general primacy requirements enumerated in this part, including that State regulations be at least as stringent as the Federal requirements):

40 CFR 142.16(l)(1). If a State chooses to use grandfathered data in the manner described in 141.26(a)(2)(ii)(C), then the State must describe the procedures and criteria which it will use to make these determinations (whether distribution system or entry point sampling points are used).

(i) The decision criteria that the State will use to determine that data collected in the distribution system are representative of the drinking water supplied from each entry point to the distribution system. These determinations must consider:

(A) All previous monitoring data.
(B) The variation in reported activity levels.
(C) Other factors affecting the representativeness of the data (e.g., geology).

Guidance

The Revised Radionuclides Rule requires systems to collect compliance samples from each EPTDS. 40 CFR 141.26(a)(2)(ii)(E) gives States the flexibility to allow systems to use monitoring data collected from the distribution system to satisfy the initial monitoring requirements.

EPA believes that requests for use of grandfathered data are best handled by States on a case-by-case basis. Therefore, to meet this special primacy requirement, State applications for program revision must demonstrate that each request for use of previously collected data will be evaluated on its merits. The application must include an explanation of how the State will use all previous monitoring data and the variation in reported activity levels. It must also explain what other factors affecting the representativeness of the data the State will use to determine if the data can be used for the initial monitoring requirement.

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For example, a State may find that the distribution samples are representative of each entry point for a system that has:

- Three wells, drawing from the same aquifer, that are from different parts of a well field,
- Three EPTDS, and
- Good historical data showing low to no uniform radionuclide occurrence from the raw water and the distribution system samples.

40 CFR 142.16(L)(2). *A monitoring plan by which the State will ensure all systems complete the required monitoring within the regulatory deadlines. States may update their existing monitoring plans or use the monitoring plans submitted for the requirements in 40 CFR 142.16(e)(5) under the National Primary Drinking Water Regulations for the inorganic and organic contaminants (i.e. the Phase II/V Rules). States may note in their applications any revision to an existing monitoring plan or note that the same monitoring plan will be used. The State must demonstrate that the monitoring plan is enforceable under State law.*

Guidance

For 40 CFR 142.16(l)(2), States should simply explain how they will modify their monitoring plans for radionuclides to fit within their existing monitoring plans for Phase II/V organic and inorganic contaminants. EPA recommends that States without Phase II/V primacy establish a schedule for initial monitoring for all of their systems. Some States may choose to phase-in the monitoring over the 3-year compliance period based on system size or source of water. Other States may simply require one-third of their systems to monitor during each year of the 3-year compliance period. States may prepare and submit such schedules with their primacy revision applications. States could also specify that they will use the schedule they developed for implementing the Phase II/V rules (standardized monitoring framework) for inorganic and organic contaminants. The Revised Radionuclides Rule was developed so that radionuclides monitoring would fit into the standardized monitoring framework. The State must also describe how the schedule will be enforced and the authority that will allow the State to enforce the schedule.

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Section IV.

Other Resources and Guidance

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IV-A. Fact Sheet

EPA United States Environmental Protection Agency
Office of Water

Ground Water and Drinking Water

EPA 815-F-00-014
November 2000

Final Radionuclides National Primary Drinking Water Regulations

EPA has revised the current radionuclides regulation, which has been in effect since 1977, by requiring new monitoring provisions that will ensure that all customers of community water systems will receive water that meets the Maximum Contaminant Levels for radionuclides in drinking water and has promulgated a standard for uranium as required by the 1986 amendments to the Safe Drinking Water Act. The current standards are: combined radium 226/228 of 5 pCi/L; a gross alpha standard for all alphas of 15 pCi/L, not including radon and uranium; a combined standard of 4 mrem/year for beta emitters. The new MCL for uranium is 30 μg/L. This final rule will provide improved health protection for 420,000 persons through monitoring improvements for the combined radium-226/-228 standard (a carcinogen) and for an additional 620,000 persons through a new standard for uranium (a kidney toxin and carcinogen) in drinking water.

Final Standards

The regulated radioactive drinking water contaminants are:

Contaminant	MCL	Source	Health Effect (Year Promulgated)
Combined radium-226/-228	5 pCi/L (1976)	Naturally occurs in some drinking water sources.	Some people who drink water containing radium -226 or -228 in excess of the MCL over many years may have an increased risk of getting cancer.
(Adjusted) Gross Alpha	15 pCi/L (not including radon or uranium)	Naturally occurs in some drinking water sources.	Some people who drink water containing alpha emitters in excess of the MCL over many years may have an increased risk of getting cancer. (1976)
Beta Particle and Photon Radioactivity	4 mrem/year (look-up table)	May occur due to contamination from facilities using or producing radioactive materials.	Some people who drink water containing beta and photon emitters in excess of the MCL over many years may have an increased risk of getting cancer. (1976)

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Contaminant	MCL	Source	Health Effect (Year Promulgated)
Uranium	30 μg/L	Naturally occurs in some drinking water sources.	Exposure to uranium in drinking water may result in toxic effects to the kidney. Some people who drink water containing alpha emitters in excess of the MCL over many years may have an increased risk of getting cancer. (2000)

Background

Radionuclides emit "ionizing radiation," a known human carcinogen, when they radioactively decay. Long-term exposure to radionuclides (see table above) in drinking water may cause cancer. As described in the Notice of Data Availability published on April 21, 2000, EPA has performed new health effects analyses based on improved scientific models and data. These new analyses demonstrate that the health effects analyses performed in 1991 generally understated the risks associated with the proposed Maximum Contaminant Level(MCL) changes. In fact, the new health effects analytical results indicate that radionuclides in drinking water are as risky (in some cases riskier) than originally estimated in 1976. For this reason, EPA has retained the more stringent 1976 MCLs in the final rule, since the proposed MCL changes were determined to be insufficiently protective of human health.

In addition, exposure to uranium in drinking water may cause toxic effects to the kidney. In 1991, EPA proposed an MCL of 20 μg/L, which was determined to be as close as feasible to the Maximum Contaminant Level Goal (MCLG). Based on human kidney toxicity data collected since then and on its estimate of the costs and benefits of regulating uranium in drinking water, EPA has determined that the benefits of a uranium MCL of 20 μg/L do not justify the costs. Instead, EPA has determined that 30 μg/L is the appropriate MCL, since it maximizes the net benefits (benefits minus costs), while being protective of kidney toxicity and carcinogenicity with an adequate margin of safety.

Provisions of the Final Radionuclides Rule

In addition to the MCLs discussed above, this final rule requires community water systems to ensure that all water served to all customers meets the MCLs for radionuclides in drinking water. This provision will be accomplished by the requirement that all future monitoring be performed such that all water entering the distribution system is tested. Under the old rule, community water systems only tested water from a "representative point" in the distribution system. The old monitoring requirements did not protect every customer, since water quality may vary significantly within the distribution system.

The monitoring frequency requirements have changed to be more consistent with the "Standardized Monitoring Framework" that are used for other drinking water standards. This improvement will result in increased consistency in monitoring requirements and will provide monitoring relief for those water systems that have very low contaminant levels.

In addition, the new rule corrects a monitoring deficiency in the 1976 framework for monitoring for combined radium-226 and -228. Under the old rule, it was assumed that radium-226 and gross alpha levels could be used to screen for radium-228. Since then, EPA has collected substantial evidence that this assumption is false. The correction involves separate monitoring requirements for radium-228 and radium-226, further ensuring that drinking water system customers will be protected from harmful radioactive contaminant levels.

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This final rule will apply only to community water systems, which are water systems with at least 15 service connections or that serve 25 or more persons year-round. EPA will further consider whether or not to regulate radionuclides levels in drinking water served by non-transient non-community water systems, which are water systems that serve at least 25 of the same people more than six months per year, such as schools, churches, nursing homes, and factories that supply their own water. EPA is consulting with the National Drinking Water Advisory Council to determine the best course of action to take with respect to regulating chronic contaminant levels for non-transient non-community water systems, including radionuclides.

Occurrence of Radionuclides in Drinking Water

Most drinking water sources have very low levels of radioactive contaminants ("radionuclides"). These very low levels are not considered to be a public health concern. Of the small percentage of drinking water systems with radioactive contaminant levels high enough to be of concern, most of the radioactivity is naturally occurring. Certain rock types have naturally occurring trace amounts of "mildly radioactive" elements (radioactive elements with very long half-lives) that serve as the "parent" of other radioactive contaminants ("daughter products"). These radioactive contaminants, depending on their chemical properties, may accumulate in drinking water sources at levels of concern. The "parent radionuclide" often behaves very differently from the "daughter radionuclide" in the environment. Because of this, parent and daughter radionuclides may have very different drinking water occurrence patterns. For example, ground water with high radium levels tend to have low uranium levels and vice versa, even though uranium-238 is the parent of radium-226.

Most parts of the United States have very low "average radionuclide occurrence" in drinking water sources. However, some parts of the country have, on average, elevated levels of particular radionuclides compared to the national average. For example, some parts of the mid-West have significantly higher average combined radium-226/-228 levels. On the other hand, some Western States have elevated average uranium levels compared to the national average. However, in general, average uranium levels are very low compared to the MCL throughout the United States. While there are other radionuclides that have been known to occur in a small number of drinking water supplies, their occurrence is thought to be rare compared to radium-226, radium-228, and uranium.

A very small percentage of drinking water systems are located in areas that have potential sources of man-made radioactive contamination from facilities that use, manufacture, or dispose of radioactive substances. Drinking water contamination may occur through accidental releases of radioactivity or through improper disposal practices. Water systems that are vulnerable to this type of contamination are required to perform extensive monitoring for radioactive contamination to ensure that their drinking water is safe. These radionuclides are regulated under the "beta particle and photon radioactivity" standard.

Costs

For the small percentage of households that are served by water systems that will be required to take corrective actions because of this rule, it is estimated that households served by typical large water systems will experience increased water bills of less than $30 per year and that households served by typical small water systems (those serving 10,000 persons or fewer) will experience increased water bills of $50 - $100 per year. Over 96 percent of the cost to water systems comes from mitigation of radionuclide levels through treatment, purchasing water, developing alternative water sources, and other compliance measures.

Since 1996, EPA's drinking water State revolving fund program has made available $3.6 billion to assist drinking water systems with projects to improve their infrastructure. EPA has funded over 1000 loans for projects around the country.

For More Information

For general information on radionuclides in drinking water, contact the Safe Drinking Water Hotline, at 1-800-426-4791, or visit the EPA Safewater website at http://www.epa.gov/safewater/ or the radionuclides website at http://www.epa.gov/safewater/radionuc.html.

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IV-B. Question and Answers

EPA United States Environmental Protection Agency
Office of Water

Ground Water and Drinking Water

EPA 815-F-00-013
November 2000

Technical Fact Sheet:
Final Rule for (Non-Radon) Radionuclides in Drinking Water

1. What are we announcing?

EPA is promulgating the final drinking water standards for (non-radon) radionuclides in drinking water: combined radium-226/-228, (adjusted) gross alpha, beta particle and photon radioactivity, and uranium. This promulgation consists of revisions to the 1976 rule, as proposed in 1991.

2. What are the requirements of this final rule?

Community water systems (CWSs), which are public water systems that serve at least 15 locations or 25 residents regularly year round, are required to meet the final MCLs and to meet the requirements for monitoring and reporting.

Non-transient, non-community water systems (NTNCWSs) will not be regulated at this time. EPA will further consider this matter and may propose to regulate radionuclides at these systems in the future. NTNCWSs are public water systems that are not a CWS and serve at least 25 of the same people more than 6 months per year (e.g. schools and nursing homes).

The final rule requires that all new monitoring be conducted at each EPTDS under a schedule designed to be consistent with the Standardized Monitoring Framework.

3. How soon after publishing the final rule will the changes take effect?

The rule will become effective three years after the December 7, 2000 promulgation date (December 8, 2003). New monitoring requirements will be phased-in between that date and the beginning of the next Standardized Monitoring Framework period, December 31 of 2007. "Phased-in monitoring" refers to the fact that States will require some fraction of water systems to complete their initial monitoring requirements each year of the period between the effective date (December 8, 2003) and the beginning of the new cycle (December 31, 2007). Water systems will determine initial compliance under the new monitoring requirements using the average of four quarterly samples or, at State discretion, using appropriate grandfathered data. Compliance will be determined immediately based on the annual average of the quarterly samples for that fraction of systems required by the State to monitor in any given year or based on the results from the grandfathered data. Water systems with existing radionuclides monitoring data demonstrating that the system is out of compliance with new provisions will be out of compliance on the effective date of December 8, 2003. Water systems with existing data that demonstrates

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non-compliance with the current (1976) rule are currently in violation of the radionuclides National Primary Drinking Water Regulations.

4. Why is this rule significant?

This rule promulgates new monitoring provisions that will ensure that all customers of community water systems will receive water that meets the Maximum Contaminant Levels for radionuclides in drinking water. Under the 1976 rule, water systems with multiple entry points to the distribution system were not required to test at every entry point, but rather to test at a "representative point to the distribution system." While the 1976 requirement did ensure that the "average customer" was protected, it did not ensure that all customers were protected. Under the new rule, all entry points will be tested and all CWS customers will be ensured of receiving water that meets the MCLs for radionuclides in drinking water. In addition, this requirement is more consistent with the monitoring requirements for other comparable drinking water contaminants.

This rule promulgates a new standard for uranium in drinking water, which will result in reduced uranium exposures for 620,000 persons. The uranium standard, which is required by the Safe Drinking Water Act, will protect drinking water customers from uranium levels that may cause toxic effects to the kidney and will reduce cancer risk. In addition, the new rule promulgates separate monitoring requirements for radium-228, which is expected to result in reduced exposure to 420,000 persons. This monitoring correction is based on sound science and is necessary for ensuring compliance with the combined radium-226/-228 standard.

5. What health effects are associated with exposure to radionuclides from drinking water?

Exposure to radionuclides from drinking water results in the increased risk of cancer. The radioactive particles (alpha, beta and gamma particles) emitted by radionuclides are called "ionizing radiation" because they ionize ("destabilize") nearby atoms as they travel through a cell or other material. In living tissue, this ionization process can damage chromosomes or other parts of the cell. This cellular damage can lead to the death of the cell or to unnatural reproduction of the cell. When a cell reproduces uncontrollably, it becomes a cancer. Certain elements accumulate in specific organs: radium (like calcium) accumulates in the bones and iodine accumulates in the thyroid.

For uranium, we must consider not only the carcinogenic health effects from its radioactive decay and the decay of its daughter products ("radiotoxicity"), but also damage to the kidneys from exposure to the uranium itself ("chemical toxicity"). Exposure to elevated uranium levels in drinking water has been shown to lead to changes in kidney function that are indicators of potential future kidney failure.

6. What are the sources of radionuclides in water?

Most drinking water sources have very low levels of radioactive contaminants ("radionuclides"), levels low enough not to be considered a public health concern. Of the radionuclides that have been observed to occur in drinking water sources, most are naturally occurring. However, contamination of drinking water sources by anthropogenic ("human-made") nuclear materials also occurs. Naturally occurring radionuclides are found in the Earth's crust and are created in the upper atmosphere. For example, trace amounts of long-lived isotopes (e.g., uranium-238, which has a half-life of almost five billion years) have been present in earth's crust since the crust first formed. As these long-lived trace radionuclides decay, shorter-lived ("more radioactive") daughter products are formed. Of particular concern are naturally occurring uranium and the naturally occurring radium isotopes, radium-226 and radium-228, which have been observed to accumulate to levels of concern in drinking water sources.

Most of the naturally occurring radionuclides are alpha particle emitters (e.g., the uranium isotopes and radium-226), but naturally occurring beta particle emitters do occur (e.g., radium-228 and potassium-40). Certain rock types contain trace amounts of the radioactive isotopes of uranium, thorium, and/or actinium. As these parent rocks weather, the resulting clays and other aquifer-forming materials may become a source of naturally-occurring radionuclides to drinking water sources. Other naturally occurring radionuclides include tritium, a beta particle emitter, which forms in the upper atmosphere through interactions between cosmic rays (nuclear particles coming from outer space) and the gases comprising the atmosphere. Tritium can be deposited from the atmosphere onto surface waters via rain or snow and can accumulate in ground water via seepage. Tritium is also formed from human activities, as described below. Natural tritium tends not to occur at levels of concern, but contamination from human activities can result in relatively high levels.

The man-made radionuclides, which are primarily beta and photon emitters, are produced by any of a number activities that involve the use of concentrated radioactive materials. These radioactive materials are used in various ways in the production of electricity, nuclear weapons, nuclear medicines used in therapy and diagnosis, and various commercial products (such as televisions or smoke detectors), as well as in various academic and government research activities. Release of man-made radionuclides to the environment, which may include drinking water sources, are primarily the result of improper waste storage, leaks, or transportation accidents.

7. How many people and how many systems will be affected by this rule?

Higher levels of radionuclides tend to be found more in ground water sources than in surface water sources, likes rivers and lakes. While most water systems do not have detectable radionuclide activities, there are some areas of the country that have levels significantly higher than the national average levels. For example, some areas of the Mid-West have elevated radium-226 levels and some Western States have elevated uranium levels compared to the rest of the United States. Separate monitoring for radium is expected to result in roughly half of one percent of the nation's 54,000 CWSs needing to take measures to lower radium in their drinking water. The uranium standard is expected to result in slightly less than one percent of CWSs needing to take measures to reduce uranium in their drinking water. Table 1 below shows the estimated number of CWSs that would be affected by this rule and the estimated population served by these public water systems.

Table 1. Estimates of the Community Water Systems That Would Need to Mitigate Contaminant Levels and the Population Served by These CWSs

Regulatory Action	Number of CWSs Affected	Total Population Served
Radium-228 Monitoring Correction	~ 300	~ 420 thousand
Uranium MCL of 30 µg/L	~ 500	~ 620 thousand

8. How much will this rule cost?

Over 96% of the cost of this final rule is expected to come from the mitigation of radionuclide levels through treatment, purchasing water, developing alternate water sources, and other compliance measures. Table 2 below shows the total annualized costs of mitigation, monitoring, reporting, recordkeeping, and administration for this rule.

Table 2. Total National Annualized Costs of the Radionuclides Rule (Mitigation, monitoring, reporting, recordkeeping, and administration)	
Regulatory Action	**Annual Costs**
Radium-228 Monitoring Correction, Mitigation Costs	~ $ 26 million
Uranium MCL of 30 µg/L, Mitigation Costs	~ $ 50 million
New Monitoring, Reporting, Record Keeping, and Administration Costs for all Radionuclides	~ $ 5 million

- For systems that need to take corrective action to comply with the new rule, the annual costs per system will range from $9,000 per year for the smallest community water systems to over $150,000 annually for systems serving 3,300 to 10,000, and over $0.5 million annually for larger systems.

- For the small percentage of households that are served by water systems that will be required to take corrective actions because of this rule, it is estimated that households served by typical large water systems will experience increased water bills of less than $30 per year and that households served by typical small water systems (those serving 10,000 persons or fewer) will experience increased water bills of $50 - $100 per year. Costs will vary depending on the system size.

9. What are the benefits of this rule?

- The requirement for separate radium-228 monitoring is expected to result in the avoidance of 0.4 cancer cases per year, with estimated monetized health effects benefits of $2 million annually. Water mitigation for radium also tends to reduce iron and manganese levels and hardness, which also has significant associated benefits.

- The kidney toxicity benefits for the uranium standard can not be quantified because limitations in existing health effects models at levels near the MCL. In addition to these non-quantified kidney toxicity benefits, 0.8 cancer cases per year are expected to be avoided, with estimated monetized cancer health effects benefits of $3 million annually. Water mitigation for uranium also removes other contaminants, which has associated benefits.

10. Is there funding associated with this rule?

Since 1996, the Drinking Water State Revolving Loan Fund has made over $3.6. billion available for loans to help water systems improve their infrastructure. This program has now made over 1000 loans. EPA also provides funding to States that have primary enforcement responsibility for their drinking water programs through the Public Water Systems Supervision (PWSS) grants program. Other federal funds are available through Housing and Urban Development's Community Development Block Grant Program, and the Rural Utilities Service of the U.S. Department of Agriculture.

11. How did EPA consult with stakeholders?

In 1997, EPA conducted a public meeting regarding the finalization of portions of the 1991 radionuclides proposal. This meeting was advertised in the *Federal Register*. During the meeting, we discussed a range

of regulation development issues with the stakeholders, including the statutory requirements, court stipulated agreement, MCLs for each of the radionuclides, the current and proposed monitoring frameworks, and new scientific information regarding health effects, occurrence, analytical methods, and treatment technologies. The presentations generated useful discussion and provided us with feedback regarding technical issues, stakeholder concerns and possible regulatory options. Participants in the stakeholder meeting included representatives from water utilities, environmental and citizens groups, State drinking water programs and health departments, other federal agencies, and other groups.

In addition, during the regulation development process, we gave presentations on the radionuclides regulation at various professional conferences, meetings between State programs and EPA Regions, the American Water Works Association's Technical Advisory Workgroup (TAW), and at Tribal meetings in Nevada, Alaska, and California. Finally, we held a one-day meeting with associations that represent State, county, and local government elected officials on May 30, 2000 and discussed five upcoming drinking water regulations, including radionuclides.

Stakeholders were also asked to comment on a variety of issues in the April 21, 2000 Notice of Data Availability. We utilized the feedback received from the stakeholders during all these meetings and comments from the NODA in developing the final radionuclides rule.

12. Where can the public get more information about the final radionuclides rule?

For general information on radionuclides in drinking water, contact the Safe Drinking Water Hotline, at (800) 426-4791, or visit the EPA Safewater website at http://www.epa.gov/safewater/ or the radionuclides website at http://www.epa.gov/safewater/radionuc.html.

In addition to this technical fact sheet, the following documents and fact sheets are available to the public at EPA's web site on radionuclides in drinking water:

- *Federal Register* notice of the Notice of Data Availability
- A Technical Support Document
- Consumer Fact Sheet on Radionuclides in Drinking Water
- The Economic Analysis for the final rule

A copy of the *Federal Register* notice of the final regulation, the Notice of Data Availability, or supporting material can be obtained by contacting the Safe Drinking Water Hotline at (800) 426-4791. The Safe Drinking Water Hotline is open Monday through Friday, excluding Federal holidays, from 9:00 a.m. to 5:30 p.m. Eastern Time.

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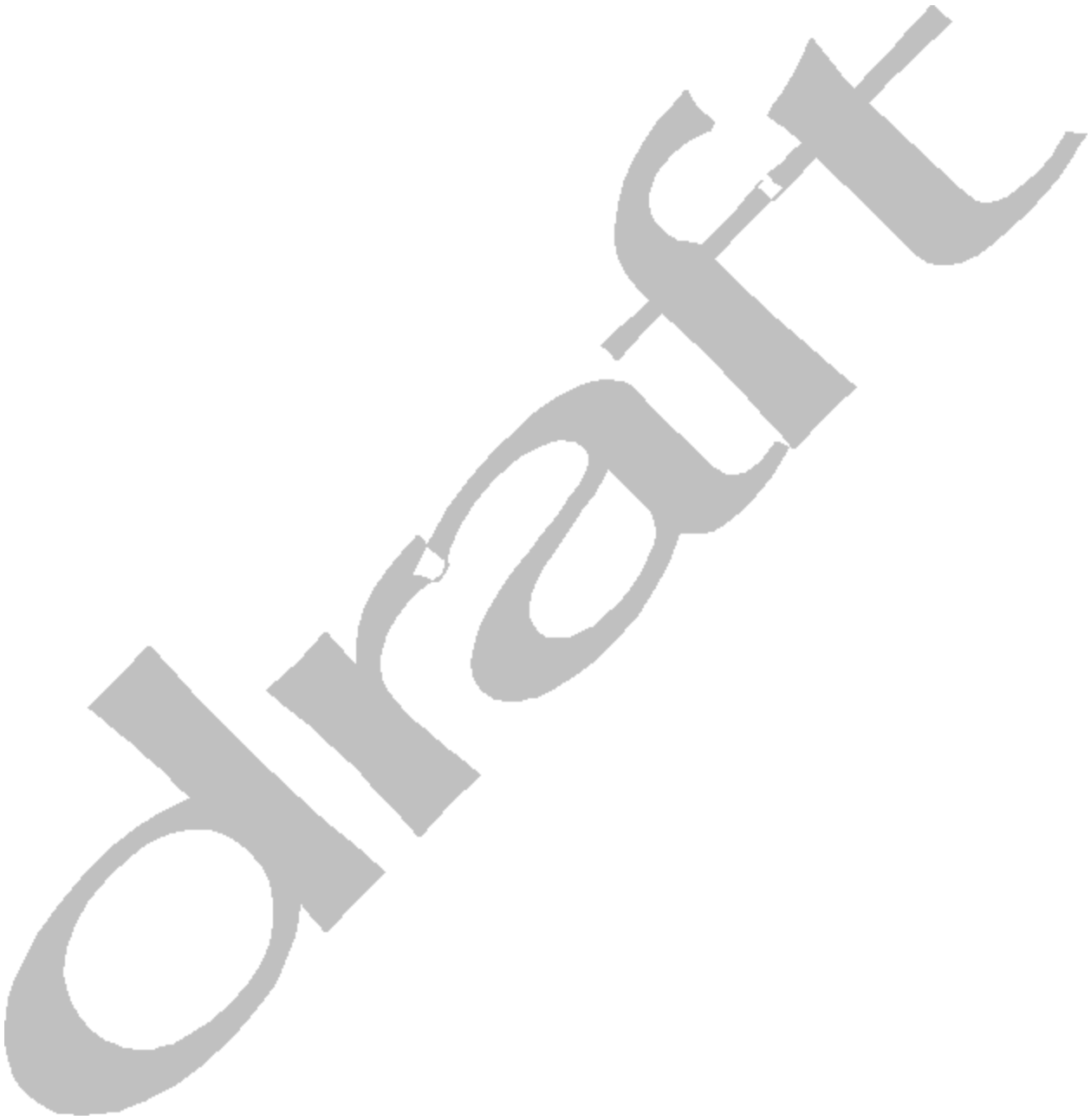
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